WILTRON

5600 SERIES
AUTOMATED SCALAR NETWORK ANALYZER SYSTEM OPERATION AND MAINTENANCE MANUAL

For use with the Model 5609, 5617, 5636, 5637, 5640, 5647, 5653, or 5659 Automated Scalar Network Analyzer System.

VOLUME II
6609A, 6617A, 6636A, 6637A, 6640A, 6647A, 6653A, or 6659A PROGRAMMABLE SWEEP GENERATOR

WILTRON

P.O. BOX 7290 • 805 E. MIDDLEFIELD ROAD • MOUNTAIN VIEW, CA 94042-7290
TEL. (415) 969-6500 • TWX 910-379-6578

2-5600-OMM
REPRINTED: AUGUST 1983

COPYRIGHT 1983 WILTRON CO.

WARRANTY

All products are warranted against defects in materials and workmanship for one year from the date of shipment except YIG-tuned oscillators, which have a two-year warranty period. Our obligation covers repairing or replacing products which prove to be defective during the warranty period and which shall be returned with transportation charges prepaid to WILTRON. Obligation is limited to the original purchaser. We are not liable for consequential damages.

TABLE OF CONTENTS

Section | Page

I GENERAL INFORMATION

1-1 Scope of the Manual 1-1

1-2 Introduction 1-1

1-3 Description 1-1

1-4 Identification Number 1-1

1-5 Options 1-1

1-6 Specifications 1-2

1-7 Characteristics 1-2

II INSTALLATION

2-1 Introduction 2-1

2-2 Initial Inspection 2-1

2-3 Preparation for Use 2-1

2-4 GPIB Setup and Interconnection 2-2
  2-4.1 Interface Connector 2-2
  2-4.2 Cable Length Restrictions 2-2
  2-4.3 GPIB Interconnection 2-3
  2-4.4 GPIB Address 2-3
  2-4.5 Data Delimiting (CR-CR/LF Switch) 2-3
  2-4.6 Option 3 (GPIB) Installation 2-4

  2-5 Preparation for Storage and/or Shipment 2-4
  2-5.1 Preparation for Storage 2-5
  2-5.2 Preparation for Shipment 2-5

III OPERATION

3-1 Introduction 3-1

3-2 Front Panel Controls 3-1
  3-2.1 DATA ENTRY Pushbuttons 3-1
  3-2.2 FREQUENCY RANGE Pushbuttons 3-6
  3-2.3 TRIGGER Pushbuttons 3-8
  3-2.4 MARKERS Pushbuttons 3-9
  3-2.5 LEVELING Controls 3-10
  3-2.6 RF OUTPUT Controls, Indicators, and Connector 3-10
  3-2.7 POWER, SELF TEST, and RESET Controls 3-11
  3-2.8 BUS ADRS/RETURN TO LOCAL Control and GPIB Indicators 3-11

TABLE OF CONTENTS (Continued)

Section Page

(III) 3-3 Rear Panel Controls and Connectors 3-13

3-4 Self-Test Features 3-13

3-5 Operational Checkout Procedures 3-21
3-5.1 Operational Checkout, Sweep Generator Confidence Test 3-21
3-5.2 Operational Checkout Procedure, FREQUENCY VERNIER Pushbuttons and Phase-Lock Operation 3-22
3-5.3 Operational Checkout Procedure, External Leveling Function (All Models Except 6642A) 3-24
3-5.4 Operational Checkout Procedure, External Leveling Function (6642A) 3-27

3-6 Description of the IEEE-488 (IEC-625) Interface Bus 3-29
3-6.1 Data Bus Description 3-30
3-6.2 Management Bus Description 3-30
3-6.3 Data Byte Transfer Control (Handshake) Bus Description 3-30

3-7 GPIB Operation (Option 3) 3-31
3-7.1 GPIB Commands: Front Panel Controls 3-32
3-7.2 GPIB Commands: Step Sweep 3-36
3-7.3 GPIB Commands, Group Execute Trigger Modes 3-37
3-7.4 GPIB Commands: Service Request Modes 3-38
3-7.5 GPIB Commands: Output 3-41
3-7.6 GPIB Commands: Miscellaneous 3-42
3-7.7 Bus Messages 3-45
3-7.8 Program Errors 3-48
3-7.9 Reset Programming and Default Conditions 3-50
3-7.10 Quick Reference Data 3-51
3-7.11 Index of Sweep Generator GPIB Command Codes 3-51

IV PERFORMANCE VERIFICATION

4-1 Introduction 4-1

4-2 Recommended Test Equipment 4-1

4-3 Frequency Accuracy Tests 4-1

4-4 Sweep Time Test 4-5

4-5 Output Power Tests 4-6

4-6 Residual AM Test 4-8

4-7 Residual FM Test 4-10

4-8 External FM and Phase-Lock Test 4-11

4-9 RF Output Signal Tests, All Models Except 6642A, 6653A, and 6659A 4-12

TABLE OF CONTENTS (Continued)

Section **Page**

(IV) 4-10 RF Output Signal Tests, Model 6642A 4-15

4-11 RF Output Signal Tests, Models 6653A and 6659A 4-18

V CALIBRATION AND ADJUSTMENTS

5-1 Introduction 5-1

5-2 Recommended Test Equipment 5-1

5-3 Adjustments Following PCB or Component Repair or Replacement 5-1

5-4 Power Supply Adjustments 5-1

5-5 A2 Ramp Generator Adjustments 5-5

5-6 A5 Frequency Instruction Adjustments 5-9

5-7 A3 Marker Generator Adjustments 5-12

5-8 A6-A9 YIG (Het/YIG) Driver PCB Adjustments 5-17
5-8.1 A6-A9 Oscillator-Bandswitching Voltage Adjustments 5-17
5-8.2 YIG Bias Check 5-21

5-9 Frequency Calibration 5-23

5-10 2-8 GHz Band (Osc 1) Tracking Filter Adjustments (Models 6617A, 6647A, 6648A, and 6659A) 5-31

5-11 Sweep Rate Compensation Adjustment 5-34

5-12 ALC Loop Calibration 5-34
5-12.1 ALC Loop Adjustments (All Models Except 6642A, 26.5 to 40 GHz Band) 5-34
5-12.2 ALC Loop Adjustments (Model 6642A, 26.5-40 GHz Band) 5-41

VI PARTS LISTS

6-1 Introduction 6-1

6-2 Parts-Ordering Information 6-1

6-3 Abbreviations 6-1

6-4 Organization of Parts Listings 6-1

VII SERVICE

7-1 Introduction 7-1

TABLE OF CONTENTS (Continued)

Section **Page**

(VII)

7-2 General Information 7-1
7-2.1 Printed Circuit Board (PCB) Exchange Program 7-1
7-2.2 Recommended Test Equipment for Troubleshooting 7-1

7-3 6600A Series Programmable Sweep Generator, Removal and Reinstallation Instructions 7-1
7-3.1 Front Panel Assembly, Removal and Reinstallation Instructions 7-1
7-3.2 Front Panel, Disassembly and Reassembly Instructions 7-3
7-3.3 INCREASE/DECREASE Lever, Switch-Assembly Replacement 7-6
7-3.4 Rear Panel Assembly, Removal and Reinstallation Instructions 7-6
7-3.5 A13 Switching Power Supply PCB, Removal and Reinstallation 7-7

7-4 6600A Series Programmable Sweep Generator, Overall Circuit Description 7-8

7-5 6600A Series Programmable Sweep Generator, Overall Troubleshooting 7-17

7-6 A12 Microprocessor PCB 7-17
7-6.1 A12 Microprocessor PCB, Circuit Description 7-17
7-6.2 A12 Microprocessor PCB, Troubleshooting Information and Data 7-27

7-7 A11 Front Panel PCB 7-35
7-7.1 A11 Front Panel PCB, Circuit Description 7-35
7-7.2 A11 Front Panel PCB, Troubleshooting Information 7-35

7-8 A1 GPIB Interface PCB 7-41
7-8.1 A1 GPIB Interface PCB, Circuit Description 7-41
7-8.2 A1 GPIB Interface PCB, Troubleshooting Information and Data 7-49

7-9 A2 Ramp Generator PCB 7-55
7-9.1 A2 Ramp Generator PCB, Circuit Description 7-55
7-9.2 A2 Ramp Generator PCB, Troubleshooting Information and Data 7-64

7-10 A3 Marker Generator PCB 7-67
7-10.1 A3 Marker Generator PCB, Circuit Description 7-67
7-10.2 A3 Marker Generator PCB, Troubleshooting Information and Data 7-77

7-11 A4 Automatic Level Control (ALC) PCB 7-83
7-11.1 A4 Automatic Level Control (ALC) PCB, Circuit Description 7-83
7-11.2 Sweep Generator Automatic Leveling Control (ALC) Loop, Troubleshooting Information and Data 7-89

TABLE OF CONTENTS (Continued)

Section **Page**

(VII) 7-12 A5 Frequency Instruction and A6-A9 YIG Driver PCBs 7-106
- 7-12.1 A5 Frequency Instruction PCB, Circuit Description 7-106
- 7-12.2 A6-A9 YIG Driver PCBs, Overall Description 7-113
- 7-12.3 Assy 660-D-8007-3, -5, -7, and -99 -91; -12868-3 and -99-91 Het/YIG Driver PCBs, Circuit Description 7-115
- 7-12.4 Assy 660-D-8007-4 Het/YIG Driver PCB, Circuit Description 7-128
- 7-12.5 Assy 660-D-8007-6 Het/YIG Driver PCB, Circuit Description 7-134
- 7-12.6 Assy 660-D-8190 and 8191 YIG Driver PCB, Circuit Description 7-140
- 7-12.7 Assy 660-D-8008 and -8009 YIG Driver PCBs (All Dash Numbers), Circuit Description 7-148
- 7-12.8 A5 Frequency Instruction and A6-A9 YIG Driver PCBs, Troubleshooting Information and Data 7-171

7-13 A10 FM/Attenuator PCB 7-175
- 7-13.1 A10 FM/Attenuator PCB, Circuit Description 7-175
- 7-13.2 A10 FM/Attenuator PCB, Troubleshooting Information and Data 7-180

7-14 RF Deck, Circuit Description 7-183

7-15 A13/A14 Switching Power Supply and A14 Motherboard PCBs 7-190
- 7-15.1 A13/A14 Switching Power Supply, Circuit Description 7-190
- 7-15.2 A4 Motherboard PCB, Wire Lists and Service Data 7-199
- 7-15.3 A13/A14 Switching Power Supply, Troubleshooting Information and Data 7-230

7-16 A18 GPIB Connector PCB, Circuit Description 7-230

APPENDIX

1 **QUICK REFERENCE DATA** A1-1

2 **STEP SWEEP STEP-TO-FREQUENCY CONVERSION FORMULA** A2-1

3 **μP OUTPUT PORTS (μP-TO-ANALOG INTERFACE)** A3-1

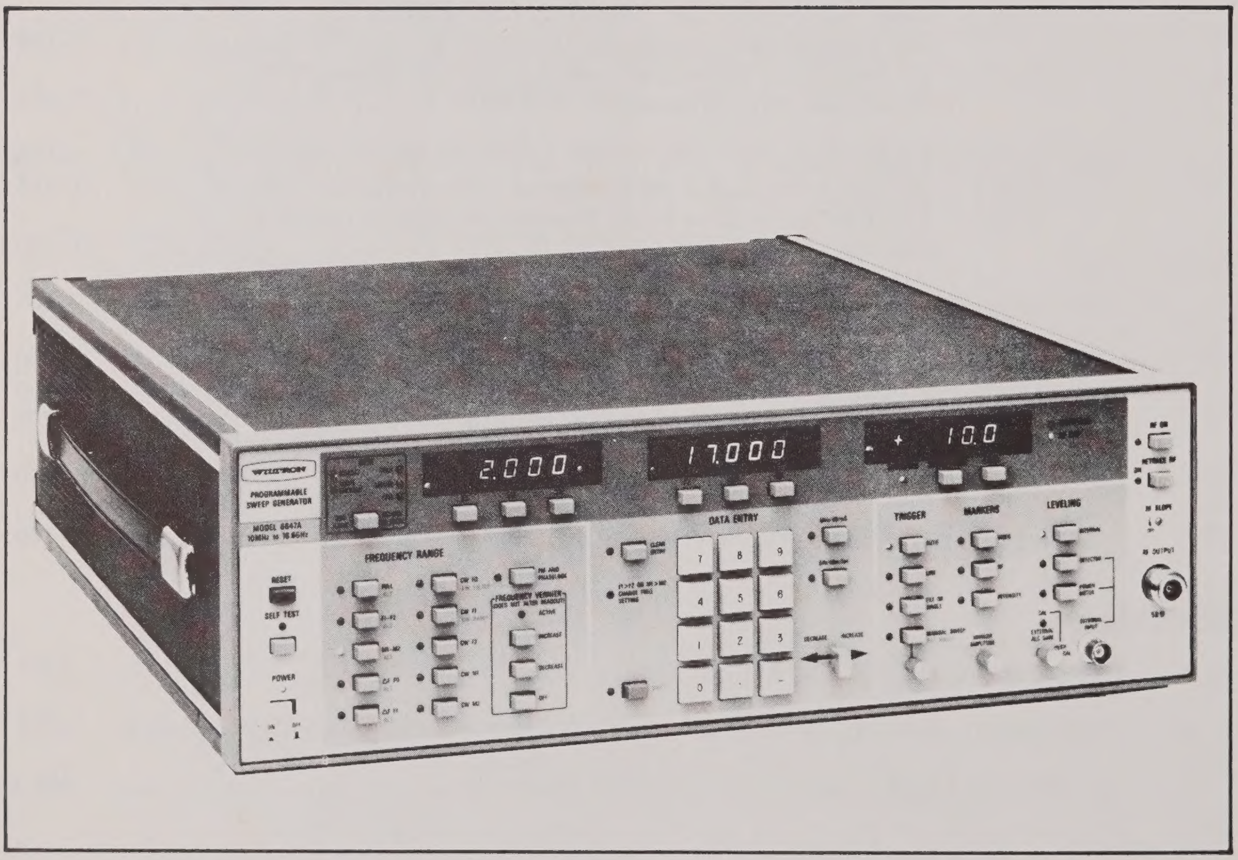


Figure 1-1. Model 6647A Programmable Sweep Generator

SECTION I

GENERAL INFORMATION

1-1 SCOPE OF THE MANUAL

This manual is the operation and maintenance (O&M) manual for the multiband models (paragraph 1-3) of the 6600A Series Programmable Sweep Generator. The manual provides general information, installation, operation, performance verification, calibration, replaceable parts, and maintenance/service information and instructions. Refer to the Table of Contents for the manual organization.

1-2 INTRODUCTION

Section I provides a description, specifications, characteristics, and option information.

1-3 DESCRIPTION

The 6600A Series (Figure 1-1) is a family of microprocessor-based, pushbutton-controlled, GPIB-capable, broadband signal sources that generate swept and CW frequencies from 10 MHz to 40 GHz. This ever-expanding family of sweepers presently consists of 29 models. These 29 models are divided into single-band and multiband sweep generators, depending upon the number of internal bands used for frequency-range coverage. Single-band models use one YIG oscillator to span their range, whereas multiband models use two or more YIGs, or a combination consisting of a YIG (or YIGs) and a frequency down-converter.

1-4 IDENTIFICATION NUMBER

All WILTRON instruments are assigned a unique six-digit ID number, such as "205001." The first digit of this ID (2 in the example) represents the instrument's year-of-manufacture; the next two (05), its manufacturing "run;" and the last three (001), its serial number. Each 6600A Series sweep generator has two ID numbers assigned, one for the basic frame and one for the RF deck. The ID number for the RF deck, which provides primary identification, is affixed to the outside of the rear panel. The basic frame ID number appears on the inside of the rear panel. Please use the primary (outside) serial number when ordering parts or when corresponding with Customer Service.

1-5 OPTIONS

The following options are available for the 6600A Series sweep generators:

- **Option 1, Rack Mount.** Sweep generator comes equipped with mounting ears and chassis track slides that have a 90° tilt capability.

- **Option 2, 10 dB Step Attenuator.** Sweep generator comes supplied with a front panel or GPIB-programmable 10 dB step attenuator. Step attenuator has a 70 dB range.

- **Option 3, GPIB Interface.** Sweep generator is equipped to operate on the IEEE-488 (IEC-625) Interface Bus. With Option 3 installed, all front panel pushbuttons except POWER are bus-programmable. Option 3 may be installed in the field.

- **Option 9, Main RF Connector on Rear Panel.** Sweep generator comes supplied with an SMA female connector installed on the rear panel rather than on the front panel.

- **Option 10, Auxiliary RF Output Connector (Rear Panel).** Sweep generator comes equipped with a second RF connector (SMA female) installed on the rear panel.

Its output power level is approximately 25 dB below the main connector power level, and its Maximum Leveled Power specification is derated by 1.5 dB.

- **Option 12, RF Output Interface, Sweep Generator to Model 661 Tracking Sweeper Controller.** Sweep generator comes supplied with a rear panel SMA connector for supplying a 10 dB attenuated RF sample to the Model 661 Tracking Sweeper Controller.

- **Option 13, Hardware Interface to HP 5342 or HP 5343A Microwave Counter.** Sweep generator comes supplied with a rear panel BNC connector that allows the HP counter to be used to count the marker frequency(ies).

- **Option 14, Data I/O Rear Panel Connector.** Sweep generator comes supplied with a 37-pin Data I/O connector for interfacing the Model 661 Tracking Sweeper Controller with the IEEE-488 Interface Bus. Sweep generator must also have Option 3 .

1-6 SPECIFICATIONS

Guaranteed performance specifications for the multiband models of the 6600A Series Programmable Sweep Generator are provided in Figure 1-2.

1-7 CHARACTERISTICS

Operational characteristics, along with brief descriptions of input and output connectors for the 6600A Series sweep generator (all models), are given in Tables 1-1 and 1-2.

Table 1-1. "RESET" Output Power Level (Power Level Indicated on LEVEL Display when RESET is Pressed)

MODEL	POWER LEVEL (dBm)			
	Standard Model	With Opt. 2	With Opt. 10	With Opt. 2 & 10
6609A	13.0	12.5	11.5	11.0
6617A	10.0	9.0	8.5	7.5
6621A	10.0	8.7	8.5	7.2
6621A-40	16.0	14.7	14.5	13.2
6629A	10.0	8.2	8.5	6.7
6629A-40	16.0	14.2	14.5	12.7
6637A	10.0	8.2	8.5	6.7
6637A-40	16.0	14.2	14.5	12.7
6638A	7.0	5.2	5.5	3.7
6642A	0.0	N/A	N/A	N/A
6647A	10.0	8.2	8.5	6.7
6648A	7.0	5.2	3.5	3.7
6653A	6.0	2.0	3.5	0.5
6659A	6.0	2.0	4.5	0.5

UNIVERSAL SPECIFICATIONS, ALL MODELS

EXTERNAL AM INPUT: Rear panel BNC connector 10k ohm impedance.
Sensitivity: 1 dB/V
Frequency Response (typical): DC–50 kHz
Input Impedance: 10 kΩ
Amplitude Control Range: >13 dB
Maximum Input: 20V

EXTERNAL FM AND PHASE LOCK INPUT: Rear panel BNC connector. 10k ohm impedance.
Sensitivity: −6 MHz/V
Maximum Deviation for Modulation Frequency of:
DC–100 kHz: ±25 MHz
100–250 kHz. ±5 MHz

EXTERNAL SQUARE WAVE INPUT: Externally applied TTL-compatible square wave modulates output at dc to 50 kHz rate. Will accommodate ±6V square wave. On/Off ratio, typically 40 dB. Maximum input, ±20 volts. Rear panel BNC connector. Not available on 6642A

POWER VARIATION WITH TEMPERATURE: ±0.5 dB/°C Not applicable to 6642A

RESIDUAL AM (50 kHz Bandwidth): >50 dBc Not applicable to 6642A

OUTPUT CONNECTOR: Type N Female, all models except
Model 6653A and 6659A: Ruggedized WSMA Female
Model 6642A: WSMA Female (18–26.5 GHz), UG-599/U (26.5–40 GHz)

SOURCE SWR SPECIFICATIONS INDIVIDUAL MODELS

MODEL	SOURCE SWR (50Ω)	SOURCE SWR WITH OPTIONS 2 AND 9
6609A	1.3	1.5
6617A	1.4 (≤2 GHz) 1.2 (>2 GHz)	1.5
6621A, 6621A-40	1.3 (<8 GHz) 1.5 (>8 GHz)	2.0
6629A, 6629A-40	1.5	2.0
6637A, 6637A-40, 6638A	1.2 (≤8 GHz) 1.4 (>8 GHz)	2.0
6642A	2.0 (18–26.5 GHz) N/A (26.5–40 GHz)	N/A
6647A, 6648A	1.4 (<2 GHz) 1.2 (2–8 GHz) 1.4 (>8 GHz)	2.0
6653A, 6659A	1.5 (≤18 GHz) 1.7 (>18 GHz)	2.0

FREQUENCY, POWER, AND PURITY SPECIFICATIONS, INDIVIDUAL MODELS

MODEL	FREQUENCY RANGE (GHz)	OUTPUT POWER (25°C ±5°)		POWER LEVEL ACCURACY			LEVELED POWER VARIATION		SIGNAL PURITY			FREQUENCY ACCURACY (25°C)		FREQUENCY STABILITY					MODEL
		INTERNALLY LEVELED MAXIMUM (dBm)	WITH OPT. 2, 70 dB ATTENUATOR (dBm)	LEVELED (dB)	WITH OPT. 2, 70 dB ATTENUATOR, ADD: (dB)	ATTENUATOR ACCURACY PER STEP (dB)	WITH FREQUENCY (dB)	WITH FREQUENCY OPT. 2, 70 dB ATTENUATOR (dB)	HARMONICS (dBc)	NON-HARMONICS (dBc)	RESIDUAL FM [3] (kHz pk)	CW MODE (MHz)	SWEEP MODE ≤50 MHz (MHz)	WITH TEMPERATURE (MHz/°C)	WITH 10% LINE VOLTAGE CHANGE (kHz)	WITH 10 dB POWER LEVEL CHANGE (kHz)	WITH 3 1 LOAD SWR (kHz)	WITH TIME, 10 MINUTES TYPICAL [4] (kHz)	
6609A	.01-2	>13	>12.5	±0.6	±0.8	±0.3	±0.3	±0.8	>30	>40	<7	±5	[illegible]	[illegible]	±100	±100	[illegible]	±200	6609A
6617A	.01-8	>10	>9	±0.9	±1	±0.4	±0.5	±1	>30 (<2 GHz) >40 (>2 GHz)	>40 (<2 GHz) >60 (>2 GHz)	<7	±5	±10	[illegible]	[illegible]	[illegible]	[illegible]	±200	6617A
6621A	2-12.4	>10	>8.7	±1	±1.5	±0.4	±0.5	±1.4	>40	>60	<10	±10	±15	[illegible]	[illegible]	±500	±300	±200	6621A
6621A-40	2-12.4	>16	>14.7	±1	±1.5	±0.4	±0.5	±1.4	>25	>60	<10	±10	±15	[illegible]	[illegible]	±500	±300	±200	6621A-40
6629A	8-18.6	>10	>8.2	±1	±1.5	±0.4	±0.5	±1.5	>40	>60	<10	±10	[illegible]	[illegible]	[illegible]	±500	±300	±200	
6629A-40	8-18.6	>16	>14.2	±1	±1.5	±0.4	±0.5	±1.5	>40	>60	<10	±10	±15	±0.5	[illegible]	±500	±300	±200	6629A-40
6637A	2-18.6	>10	>8.2	±1	±1.5	±0.4	±0.5	±1.5	>40	>60	<7 (<8 GHz) <10 (>8 GHz)	±10	±15	±1.5	[illegible]	[illegible]	±400	±200	6637A
6637A-40	2-18.6	>16	>14.2	±1	±1.5	±0.4	±0.5	±1.5	>25	>60	<7 (<8 GHz) <10 (>8 GHz)	±10	±15	[illegible]	[illegible]	±500	±300	±200	6637A-40
6638A	2-20	>10 (≤18 GHz) >7 (>18 GHz)	>8.2 (≤18 GHz) >5.2 (>18 GHz)	±1	±1.5	±0.7	±0.5	±1.5	>40	>60	<7 (<8 GHz) <10 (>8 GHz)	±10	[illegible]	[illegible]	[illegible]	±500	[illegible]	±200	6638A
6642A	18-40	>5 (18-26.5 GHz) >0 (26.5-40 GHz)[1]	N/A	±2 (<26.5 GHz) N/A (>26.5 GHz)	N/A	N/A	±1 (<26.5 GHz) N/A (>26.5 GHz)	N/A	>30 (<26.5 GHz) >20 (>26.5 GHz)	>60	<30 (<26.5 GHz) <40 (>26.5 GHz)	±15 (<26.5 GHz) ±20 (>26.5 GHz)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	±400	6642A
6647A	.01-18.6	>10	>8.2	±1	±1.5	±0.4	±0.6	±1.5	30 (<2 GHz) >40 (>2 GHz)	>40 (<2 GHz) >60 (>2 GHz)	<7 (<8 GHz) <10 (>8 GHz)	±10	±15	[illegible]	[illegible]	±500	±300	[illegible]	6647A
6648A	.01-20	>10 (≤18 GHz) >7 (>18 GHz)	>8.2 (≤18 GHz) >5.2 (>18 GHz)	±1	±1.5	±0.7	±0.6	±1.5	>30 (<2 GHz) >40 (>2 GHz)	>40 (<2 GHz) >60 (>2 GHz)	<7 (<8 GHz) <10 (>8 GHz)	±10	±15	[illegible]	[illegible]	±500	±300	±200	6648A
6653A	2-26.5	>10 (≤18 GHz) >6 (>18 GHz)	>7 (≤18 GHz) >2 (>18 GHz)	±1	±2	±0.7	±1.0	±1.5	>40	>60	<7 (<8 GHz) <10 (8 to 18 GHz) <15 (>18 GHz)	[illegible]	±30	±1	[illegible]	[illegible]	±300	±200	6653A
6659A	.01-26.5	>10 (≤18 GHz) >6 (>18 GHz)	>5 (≤18 GHz) >1.6 (>18 GHz)	±1	±2	±0.7	±1.0	±1.5	>30 (<2 GHz) >40 (>2 GHz)	>40 (<2 GHz) >60 (>2 GHz)	<7 (<8 GHz) <10 (8 to 18 GHz) <15 (>18 GHz)	±20	±30	[illegible]	±100	±50	[illegible]	±200	6659A

[1] External leveling only.
[2] Excluding 5% band edges where specification is >20 dBc
[3] Measured in 30 Hz–15 kHz bandwidth
[4] After 30 minutes warmup at selected CW frequency

Figure 1-2. Specifications

Table 1-2. Characteristics, 6600A Series Sweep Generators

SWEEP TIME: Continuously adjustable from .01 to 99 seconds, displayed on front panel LED readout.

SWEEP MODES:

Full Sweep: Sweeps full band in one continuous frequency sweep. The high- and low-end frequency points are displayed on the front panel.

F1 to F2 Sweep: Sweeps between user-selected frequencies (F1 and F2), which are displayed on the front panel.

M1 to M2 Sweep: Sweeps between user-selected frequencies (M1 and M2), which are displayed on the front panel.

ΔF F0 Sweep: Sweeps symmetrically about a center frequency (F0) that is user-selected. F0 frequency and sweep-width frequency range are simultaneously displayed on the front panel.

ΔF F1 Sweep: Sweeps symmetrically about a center frequency (F1) that is user-selected. F1 frequency and sweep-width frequency range are simultaneously displayed on the front panel.

CONTINUOUS WAVE (CW) MODES:

CW F0
CW F1
CW F2
CW M1
CW M2

Fixed frequency CW output at the respective F0, F1, F2, M1, or M2 frequency point. The frequency of the CW signal is displayed on a front-panel LED readout.

FINE-FREQUENCY CONTROL:

Frequency Vernier controls are available and may be used with a microwave counter to finely adjust (1) the output frequency in any CW mode or (2) the center frequency in either ΔF sweep mode. Without changing the frequency appearing on the applicable numeric display, these pushbuttons will change the output frequency by up to ±10 MHz for all models except the 6642A, 6653A, and 6659A. For these three models, the output frequency can be changed by up to ±25 MHz.

TRIGGER MODES:

Automatic: Sweep recurs automatically.

Line: Sweep recurs in sync with the line frequency or in sync with multiples of the line frequency.

External or Single: Sweep recurs when triggered. Triggering can be accomplished either from the front panel or by applying an external pulse to the rear panel.

Manual: Frequency may be swept manually between upper and lower frequency limits, using the front-panel MANUAL SWEEP control.

MARKERS:

Video: Positive video pulse(s). Markers appear at frequencies M1, M2, and F0, depending upon sweep mode. In the FULL, F1-F2, and ΔF F1 modes, three markers are available. In the ΔF F0 mode, two markers (M1 and M2) are available. And, in the M1-M2 mode, one marker (F0) is available. The frequency and amplitude of the marker(s) may be controlled from the front panel.

RF: Negative RF pip(s). Markers appear at frequencies M1, M2, and F0, as described for Video above. The frequency and amplitude of the marker(s) may be controlled from the front panel.

Intensity: Intensity dot(s) are created when the sweep is made to dwell momentarily at the marker frequency(ies). No connection between the sweep generator and the CRT Z-axis is

Table 1-2. Characteristics, 6600A Series Sweep Generator (Continued)

required. Markers appear at frequencies M1, M2, and F0, as described for "Video" above. The frequency of the marker(s) may be selected from the front panel.

LEVELING MODES:

Internal: The output power is sampled internally and used to provide leveled RF power at the RF OUTPUT connector.

Detector: The output power may be sampled externally using a coupler and detector, and used to provide leveled RF power at the device under test.

Power Meter: The output power may be sampled externally using a coupler and a power meter, and used to provide leveled RF power at the device under test.

SHIFTED FUNCTIONS:

Alternating Sweep: Sweep generator alternates between any two of the five frequency-sweep ranges: Full, F1-F2, M1-M2, ΔF F0, ΔF F1. When used with a compatible network analyzer, such as the WILTRON 560A, this function allows two sweeps to be input into the same channel through a single RF detector or SWR Autotester.

CW Filter, Enable-Disable: Provides for switching the CW filter out of the YIG oscillator tuning circuit. This filter is automatically inserted for CW and narrow (≤50 MHz) sweep modes.

CW Ramp, On-Off: Provides a 0-10V horizontal sweep ramp during CW modes. When the sweep generator is used with the WILTRON Model 560 or 560A Scalar Network Analyzer, this sweep ramp causes the network analyzer to display a trace (rather than a dot) when the sweep generator outputs a CW frequency.

External Sweep: Provides for sweeping the output frequency using an externally supplied sweep ramp, which is input via the rear panel EXT SWEEP connector.

SELF TEST: Diagnostic self-test routines are accomplished each time the unit is turned on and when the front-panel SELF TEST pushbutton is pressed. In the event of a self-test failure, an error code is displayed on front-panel LED readouts. If the unit passes, the word PASS is indicated on an LED readout.

EXTERNAL LEVELING CONTROL (ALC):

The gain of the external leveling input (detector or power meter) may be calibrated from the front panel for all models except 6642A; the use of an external indicating device such as an oscilloscope is not necessary.

RESET: Sweep generator operation in either the local (front panel) or remote (GPIB) operational mode can be reset to a predetermined state by pressing the front panel RESET pushbutton.

GPIB OPERATION: All front-panel pushbuttons except POWER can be programmed over the IEEE-488 Interface Bus (GPIB). Front-panel indicators light when:

1. the sweeper is under GPIB (remote) control.
2. Local Lockout is programmed.
3. a Service Request (SRQ) is initiated.
4. the sweeper is addressed to either Talk or Listen.

A chart showing GPIB subset capability is given in Figure 3-30.

Table 1-2. Characteristics, 6600A Series Sweep Generators (Continued)

INPUT/OUTPUT CONNECTORS:

Horizontal Output: 0 to 10 volts during all sweep and CW modes (if CW RAMP is activated). <100Ω impedance.

Seq Sync Output: Positive TTL-level pulse during sweep retrace.

Retrace Blanking (+) Output: +5 volt, TTL-compatible pulse during retrace blanking.

Retrace Blanking (–) Output: -5 volt pulse during retrace blanking.

Marker Output: 0 to +5 volt pulse when video marker is selected. Pulse amplitude depends upon front panel MARKERS AMPLITUDE control. 1 kΩ impedance.

Bandswitch Blanking Output: ±5 volts, depending upon BANDSWITCH BLANKING switch, during oscillator bandswitching. <100Ω impedance. Not used in Single-Band models.

1V/GHz Output: 1 volt per GHz of output frequency (.5V/GHz for 6636A and 6640A). <100Ω impedance.

Penlift Output: Normally-open relay contacts for lifting recorder pen during retrace. Internal jumper available for normally-closed contacts.

Sweep Trigger Input: When TRIGGER–EXT OR SINGLE pushbutton is engaged, an externally applied clock pulse with the below-listed characteristics triggers a sweep upon closure-to-ground.

Amplitude: 4 to 25 Vpk
Pulse Width: >1 µs
Fall Time: <5 µs
Polarity: Low true

Sweep Dwell Input: +5V (maximum) TTL pulse causes frequency sweep to dwell. Provides interface for HP 8410 Network Analyzer.

External AM Input: Provides for amplitude modulation of the output signal. 10 kΩ input impedance and 1V/dB input sensitivity.

External FM and Phase Lock Input: Provides for frequency modulation of the output signal. 10 kΩ input impedance and -6 MHz/V input sensitivity.

External Square Wave Input: TTL-compatible input that allows a ±10 volt (maximum) square wave to modulate the RF output signal. Input square wave frequency from dc to 50 kHz.

External Sweep Input: Allows a 0 to 10 volt external sweep ramp to sweep the output frequency. 10 kΩ input impedance.

NONVOLATILE STORAGE: Front-panel control settings are retained in an internal memory (storage) when the ac power is turned off. When the ac power is turned on again, the previously-stored control settings are returned. The internal memory is powered by a rechargeable battery. Battery charge will last approximately 20 days when the sweeper is turned off and will be automatically recharged when the sweeper is turned on again.

INPUT POWER: 100, 115-120 Vac (+5%, -10%) at 2.0A rms or 220, 230-240 Vac (+5%, -10%) at 1.0A rms, 44-68 Hertz.

OPERATING TEMPERATURE RANGE: 0 to 50 degrees centigrade.

PHYSICAL:

Height: 13.34 cm (5.25 inches)
Width: 43.18 cm (17 inches)
Depth: 47.6 cm (18.75 inches)
Weight: 15.08 kg (33.5 pounds)

SECTION II

INSTALLATION

2-1 INTRODUCTION

This section provides information on initial inspection, preparation for use, and General Purpose Interface Bus (GPIB) interconnections. Also included is information concerning reshipment and storage of the sweep generator.

2-2 INITIAL INSPECTION

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the sweep generator is damaged mechanically, notify your local sales representative or WILTRON Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as WILTRON. Keep the shipping materials for carrier's inspection.

2-3 PREPARATION FOR USE

Preparation for use consists of checking that the sweep generator is set for the correct line voltage. The line-voltage module on rear panel enables the sweep generator to be used with any of four international line voltages: 100, 115/120, 220, or 230/240. Before leaving the factory, each sweep generator is preset and tagged for the line voltage present in the customer's area. If the actual line voltage is different from that stated on the tag, the following procedure gives instructions for changing the line-voltage selector card.

a. Refer to Figure 2-1. Disconnect the power cord from the voltage selector module ① and slide cover ② down to gain access to the fuse compartment.

b. To select a different line voltage:

   1. Pull on FUSE PULL ③ and remove line fuse ④ and PC board ⑤ .

      NOTE

      The PC board is tightly secured within the module housing. It may be necessary to use needle-nose pliers or a similar tool as a pry.

   2. Using the example for 115/120 Vac operation (Figure 2-1) as a guide, reinstall the PC board. For the correct installation of this board, the desired line-voltage callout should be located:

      a. adjacent to the input receptacle and

      b. facing toward the BNC connector-bank.

   3. Push the FUSE PULL back to its normal position and insert a fuse of the proper value (as indicated on the right side of the module) into the fuse holder.

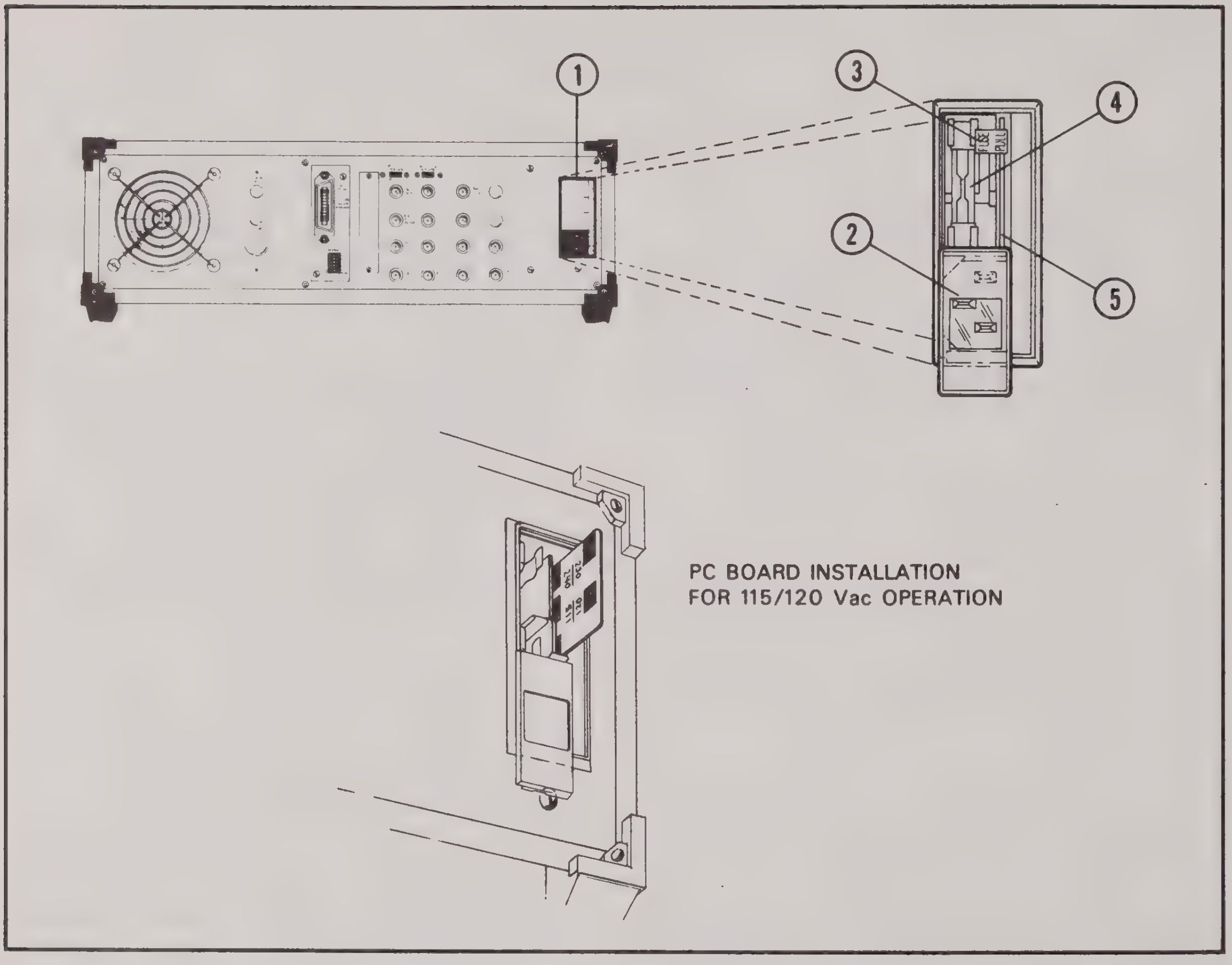


Figure 2-1. Line Voltage Selector Module

2-4 GPIB SETUP AND INTERCONNECTION

With Option 3 installed, the sweep generator is capable of providing automated microwave measurements via the GPIB. Specific GPIB information – including interface connections, cable requirements, and addressing instructions – is contained in the following paragraphs.

2-4.1 Interface Connector

Interface between the sweep generator and other devices on the GPIB is via a 24-wire interface cable. The interface cable is specifically constructed with each end containing a connector shell with two connector faces. These double-faced connectors allow for parallel connection of two or more cables to a single device. Figure 2-2 shows the pin assignments for the Type 57 GPIB connector, installed on the rear panel.

2-4.2 Cable Length Restrictions

The GPIB system can accommodate up to fifteen instruments at any one time. To achieve design performance on the bus, the proper timing and voltage level relationships must be maintained. If either the cable length between separate instruments or the accumulated cable length between all instruments is too long, the data and control lines

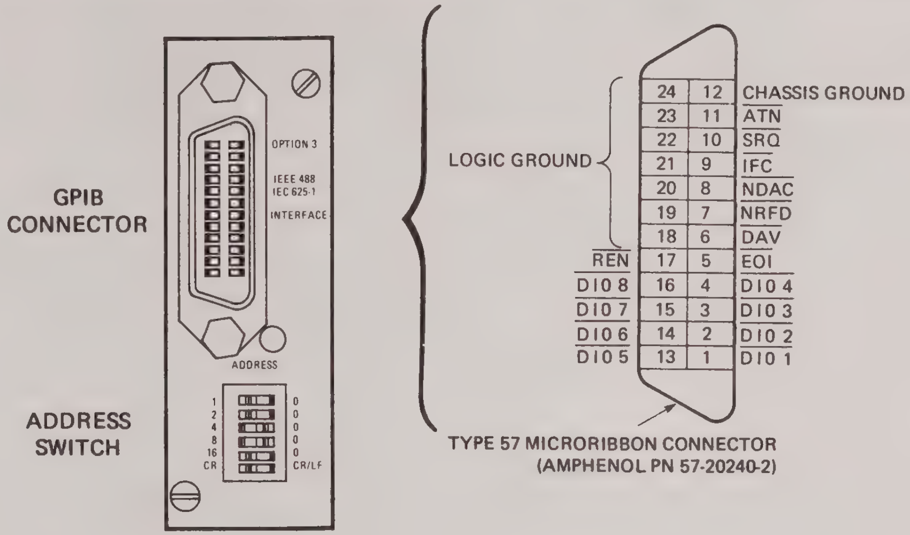

GPIB CONNECTOR
ADDRESS SWITCH
OPTION 3
IEEE 488
IEC 625-1
INTERFACE
ADDRESS
1
2
4
8
16
CR
0
0
0
0
0
CR/LF
LOGIC GROUND
24 12 CHASSIS GROUND
23 11 ATN
22 10 SRQ
21 9 IFC
20 8 NDAC
19 7 NRFD
18 6 DAV
REN 17 5 EOI
DIO 8 16 4 DIO 4
DIO 7 15 3 DIO 3
DIO 6 14 2 DIO 2
DIO 5 13 1 DIO 1
TYPE 57 MICRORIBBON CONNECTOR
(AMPHENOL PN 57-20240-2)

Figure 2-2. Option 3 Panel (ADDRESS Switch and GPIB Connector)

cannot be driven properly and the system may fail to perform. Cable length restrictions are as follows:

- No more than 15 instruments may be installed on the bus.
- Total accumulative cable length in meters may not exceed 2 times the number of bus instruments, or 20 meters – whichever is less.

2-4.3 GPIB Interconnection

The only interconnection required for GPIB operation is between the sweep generator and the controller. To accomplish this interconnection, a special cable is required. This cable – WILTRON Part No. 2000-1, -2, or -4 (1, 2, or 4 meters in length) – is available from the factory.

2-4.4 GPIB Address

The sweep generator is shipped from the factory preset to address 5. If a different address is desired, the ADDRESS switches on the Option 3 panel (Figure 2-2) provide for the selection of any address number between 0 and 30. Figure 2-3 provides a tabulation of the available address numbers, and Figure 2-4 provides an example of how an address number is selected.

2-4.5 Data Delimiting (CR-CR/LF Switch)

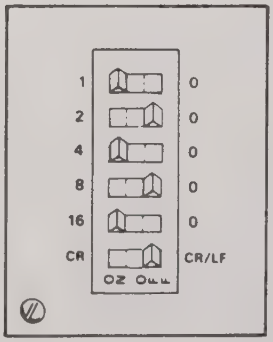
On the GPIB, data delimiting is accomplished using either the carriage return (CR) or both the carriage return and the line feed (CR/LF) ASCII characters, depending upon the requirements of the instrument used as system controller. For example, the PET 2001 requires CR. The HP 9825A requires CR/LF, while the WILTRON 85 and the Tektronix 4051 can use either CR or CR/LF.

To provide ease in selecting the proper data-delimiting character for the controller in use, a switch is provided on the rear Option 3 panel. To use this switch, simply press the rocker arm to the position of the required delimiting character (Figure 2-4).

Decimal Address	ASCII Character	(MSB) 16	8	4	2	(LSB) 1
0	Space	0	0	0	0	0
1	!	0	0	0	0	1
2	"	0	0	0	1	0
3	#	0	0	0	1	1
4	$	0	0	1	0	0
5	%	0	0	1	0	1
6	&	0	0	1	1	0
7	'	0	0	1	1	1
8	(	0	1	0	0	0
9	)	0	1	0	0	1
10	*	0	1	0	1	0
11	+	0	1	0	1	1
12	,	0	1	1	0	0
13	-	0	1	1	0	1
14	.	0	1	1	1	0
15	/	0	1	1	1	1
16	0	1	0	0	0	0
17	1	1	0	0	0	1
18	2	1	0	0	1	0
19	3	1	0	0	1	1
20	4	1	0	1	0	0
21	5	1	0	1	0	1
22	6	1	0	1	1	0
23	7	1	0	1	1	1
24	8	1	1	0	0	0
25	9	1	1	0	0	1
26	:	1	1	0	1	0
27	;	1	1	0	1	1
28	<	1	1	1	0	0
29	=	1	1	1	0	1
30	>	1	1	1	1	0

Switch ON = 1
Switch OFF = 0

Figure 2-3. Available Address Codes and Corresponding ADDRESS Switch Positions



GPIB ADDRESS = 10 (2+8)

DATA DELIMITER = CR

Figure 2-4. Address Selection

2-4.6 Option 3 (GPIB) Installation

Option 3, which consists of the A1 PCB and the A18 GPIB Connector Assembly, may be installed in the field, as follows:

a. Remove the rear panel cover plate and install the A18 Connector Assembly. See Figure 3-20, index number 3, for location.

b. Connect the A18P1 connector to A14P4, on the motherboard. See Figure 7-125 for location.

c. Install the A1 PCB into its marked slot in the 660-D-8000 Mainframe Assembly. See Figure 6-1, index number 1, for location.

2-5 PREPARATION FOR STORAGE AND/OR SHIPMENT

Instructions for preparing the sweep generator for storage, shipment, or both are provided in paragraphs 2-5.1 and 2-5.2.

2-5.1 Preparation for Storage

Preparation for storage involves cleaning the unit, packing the inside of the unit with moisture-absorbing dessicant crystals, and storing the unit in a temperature environment between -40 and +70 degrees centigrade.

2-5.2 Preparation for Shipment

To provide maximum protection against damage in transit, the sweep generator should be repackaged in the original shipping container. If this container is no longer available and the sweep generator is being returned to WILTRON for repair, contact WILTRON Customer Service and a new shipping container will be sent to you free of charge. In the event neither of these two options is possible, the following paragraphs provide instructions for packaging and shipment.

a. Use a Suitable Container. Obtain a corrugated cardboard carton with a 275-pound test strength and inside dimensions of no less than six inches more than the instrument dimensions; this allows for cushioning.

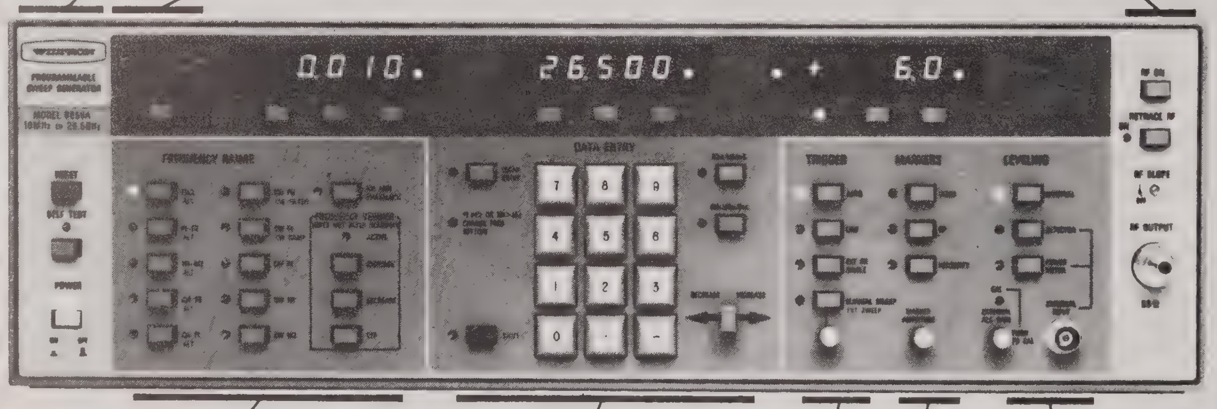
b. Protect the Instrument. Surround the instrument with polyethylene sheeting to protect the finish.

c. Cushion the Instrument. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument; allow a minimum of three inches of dunnage on all sides.

d. Seal the Container. Seal the carton by using either shipping tape or an industrial stapler.

e. Address the Container. If the instrument is being returned to WILTRON for service, mark the WILTRON address and your return address on the carton in one or more prominent locations. The WILTRON address is:

WILTRON Company
ATTN: Customer Service
825 E. Middlefield Road
Mountain View, CA 94043



POWER, SELF TEST, and RESET Pushbuttons - Provide for turning power on/off, performing self test, and resetting front-panel controls to a known state. Individual pushbuttons are described in paragraph 3-2.7.

BUS ADRS/RETURN TO LOCAL Pushbutton and GPIB Indicators - Provide for the display of GPIB status and address information, plus, if the sweep generator is in the GPIB mode of operation, return to local (front panel) control. The pushbutton and indicators are described in paragraph 3-2.8.

RF OUTPUT Pushbutton, Indicators, and Connector - Provide for the output and control of the RF output function. Individual pushbuttons and indicators, along with the connector, are described in paragraph 3-2.5.

FREQUENCY RANGE Pushbuttons - Control the frequency sweep and CW output of the sweep generator. Individual pushbuttons are described in paragraph 3-2.2.

DATA ENTRY and SHIFT Pushbuttons - The data entry controls provide for inputting frequency, sweep time, and output-power level information. The SHIFT pushbutton provides alternate functions for certain controls. Individual pushbuttons are described in paragraph 3-2.1.

TRIGGER Pushbuttons - Provide for sweep triggering. Individual pushbuttons are described in paragraph 3-2.3.

MARKERS Pushbuttons - Provide for markers. Individual pushbuttons are described in paragraph 3-2.4.

LEVELING Pushbuttons and Connector - Provide for RF output leveling. Individual pushbuttons, along with the connector, are described in paragraph 3-2.5.

Figure 3-1. Sweep Generator Front Panel Controls

SECTION III

OPERATION

3-1 INTRODUCTION

This section contains information on the front and rear panel controls and connectors, plus a description of the sweep generator self-test feature. Also included are operational checkout procedures and a description of the Option 3 GPIB command codes.

3-2 FRONT PANEL CONTROLS

The front panel controls are grouped by function, as shown in Figure 3-1. Detailed descriptions of individual controls within each group are given in paragraphs 3-2.1 thru 3-2.8.

3-2.1 DATA ENTRY Pushbuttons

There are five discrete frequency parameters (F0, F1, F2, M1, and M2) and one sweep width parameter (ΔF) – plus the sweep time and RF-output power level parameters – used to control the operation of the sweep generator. The DATA ENTRY pushbuttons (Figure 3-2) provide for entering new values for these parameters.

To provide an overview, several examples of how these pushbuttons are used to accomplish data entry are given in Figure 3-3. Individual DATA ENTRY pushbuttons are described in subparagraphs a. through f.

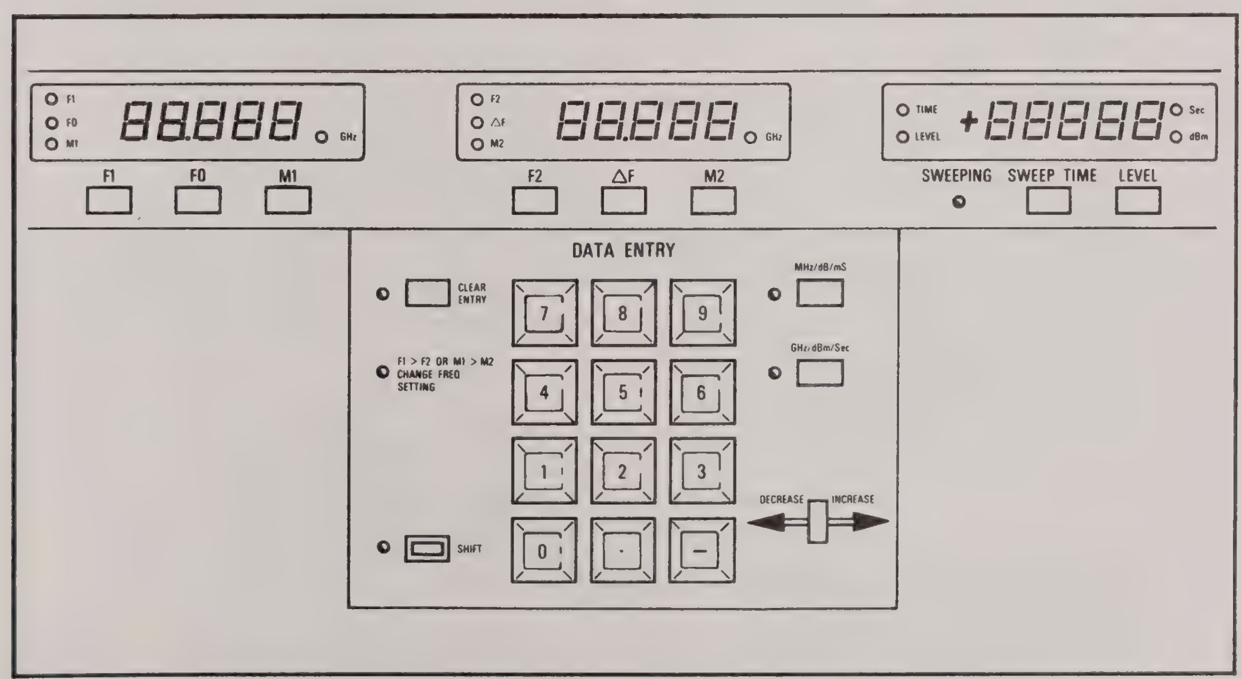
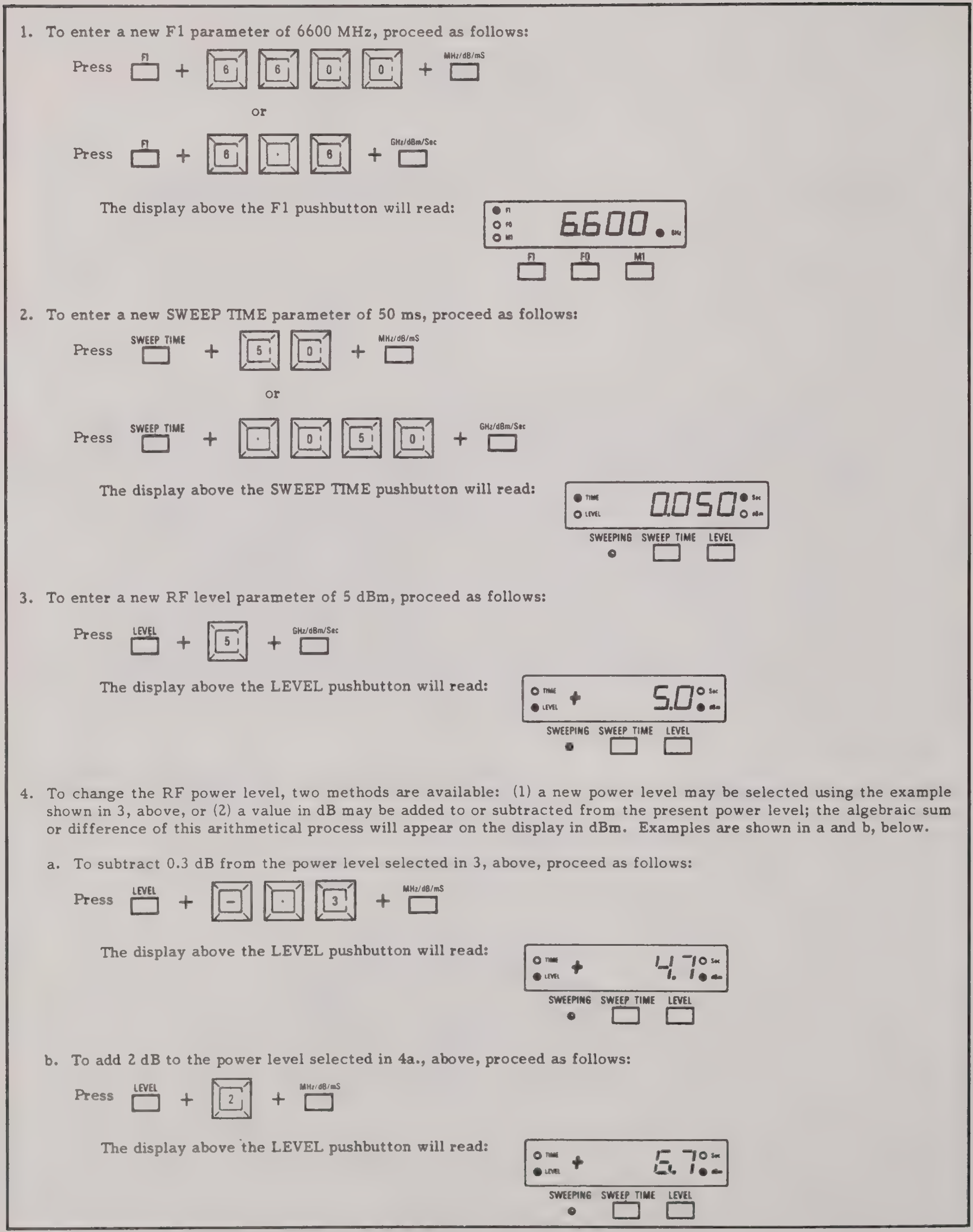

F1
F0
M1
GHz
F2
ΔF
M2
GHz
TIME
LEVEL
Sec
dBm
F1
F0
M1
F2
ΔF
M2
SWEEPING
SWEEP TIME
LEVEL
DATA ENTRY
CLEAR ENTRY
F1 > F2 OR M1 > M2 CHANGE FREQ SETTING
SHIFT
7
8
9
4
5
6
1
2
3
0
.
−
MHz/dB/mS
GHz/dBm/Sec
DECREASE
INCREASE

Figure 3-2. DATA ENTRY Pushbuttons



1. To enter a new F1 parameter of 6600 MHz, proceed as follows:

Press F1 + 6 6 0 0 + MHz/dB/mS

or

Press F1 + 6 . 6 + GHz/dB/Sec

The display above the F1 pushbutton will read:

● F1
○ F0
○ M1
6.600
GHz
F1
F0
M1

2. To enter a new SWEEP TIME parameter of 50 ms, proceed as follows:

Press SWEEP TIME + 5 0 + MHz/dB/mS

or

Press SWEEP TIME + . 0 5 0 + GHz/dB/Sec

The display above the SWEEP TIME pushbutton will read:

● TIME
○ LEVEL
0.050
● Sec
○ dBm
SWEEPING
SWEEP TIME
LEVEL

3. To enter a new RF level parameter of 5 dBm, proceed as follows:

Press LEVEL + 5 + GHz/dB/Sec

The display above the LEVEL pushbutton will read:

○ TIME
● LEVEL
+
5.0
○ Sec
● dBm
SWEEPING
SWEEP TIME
LEVEL

4. To change the RF power level, two methods are available: (1) a new power level may be selected using the example shown in 3, above, or (2) a value in dB may be added to or subtracted from the present power level; the algebraic sum or difference of this arithmetical process will appear on the display in dBm. Examples are shown in a and b, below.

a. To subtract 0.3 dB from the power level selected in 3, above, proceed as follows:

Press LEVEL + − . 3 + MHz/dB/mS

The display above the LEVEL pushbutton will read:

○ TIME
● LEVEL
+
4.7
○ Sec
● dBm
SWEEPING
SWEEP TIME
LEVEL

b. To add 2 dB to the power level selected in 4a., above, proceed as follows:

Press LEVEL + 2 + MHz/dB/mS

The display above the LEVEL pushbutton will read:

○ TIME
● LEVEL
+
6.7
○ Sec
● dBm
SWEEPING
SWEEP TIME
LEVEL

Figure 3-3. How to Enter Parameter Data (Examples)

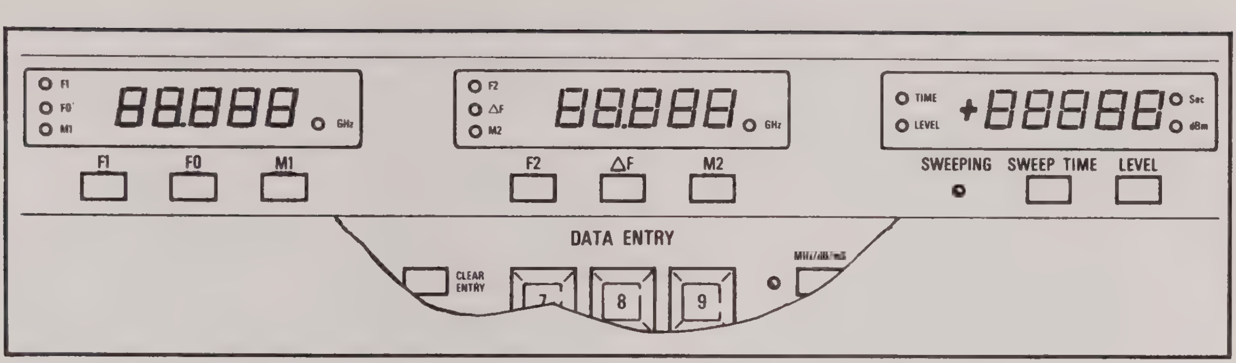

F1
F0
M1
GHz
F2
ΔF
M2
GHz
TIME
LEVEL
Sec
dBm
F1
F0
M1
F2
ΔF
M2
SWEEPING
SWEEP TIME
LEVEL
DATA ENTRY
CLEAR ENTRY
8
9

Figure 3-4. F1, F0, M1, F2, ΔF, M2, SWEEP TIME and LEVEL Pushbuttons and SWEEPING Indicator

a. F1, F0, M1, F2, ΔF, M2, SWEEP TIME, and LEVEL Pushbuttons and SWEEPING Indicator (Figure 3-4).

  1. The pushbuttons enable the selected parameter's value to be changed via the DATA ENTRY keypad or the INCREASE/DECREASE lever or to be monitored via the appropriate LED readout. The parameter that is selected for either changing or monitoring is hereafter known as the **selected parameter.**

  2. The SWEEPING Indicator lights during the forward portion of the frequency sweep. The indicator is out during retrace.

b. DATA ENTRY Keypad (Figure 3-5). The DATA ENTRY keypad is used to change the value of the selected frequency, sweep time, or level parameter. When the selected parameter is frequency (F1, F0, M1, F2, ΔF, or M2), the new value may be entered in either MHz or GHz. When the selected parameter is sweep time, the new value may be entered in either seconds or milliseconds. And, when the selected parameter is power level, the new value may be entered in either dB or dBm.

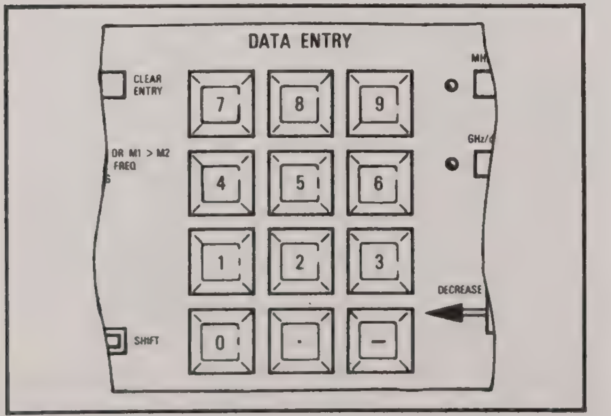

DATA ENTRY
CLEAR ENTRY
7
8
9
OR M1 > M2 FREQ
4
5
6
1
2
3
DECREASE
SHIFT
0
.
–

Figure 3-5. DATA ENTRY Keypad

c. INCREASE/DECREASE Lever (Figure 3-6). When enabled by a parameter pushbutton (F1, SWEEP TIME, LEVEL, etc.), this lever may be used to increase or decrease the parameter's value. The length of lever travel, either right or left, determines the rate at which the parameter's value increases or decreases. To increase or decrease the parameter's value in one-increment steps, "tap" the switch in the direction of desired change. When the lever is "tapped," a frequency parameter will change in 1 MHz increments. An RF level parameter will

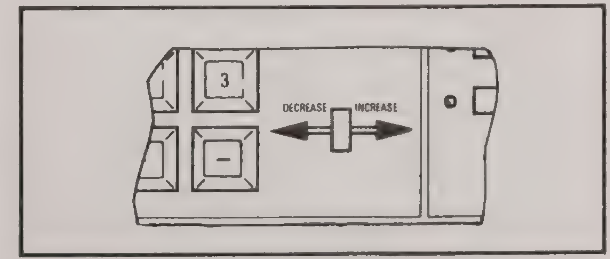

3
–
DECREASE
INCREASE

Figure 3-6. INCREASE/DECREASE Lever

change in 0.1 dB increments. And, a sweep time parameter will change in 1 ms increments between .01 and 1.0 seconds, 0.1-second increments between 1 and 10 seconds, and 1-second increments between 10 and 99 seconds.

NOTE

> For SWEEP TIME, move the lever toward DECREASE to increase time, and toward INCREASE to decrease time.

d. MHz/dB/mS and GHz/dBm/Sec Pushbuttons (Figure 3-7). These two pushbuttons are data string terminators. That is, they mark the end of a parameter-input entry, and they assign the appropriate units (GHz, dBm, mS, etc.) to the entry. However, whereas

- a frequency parameter may be ended in either MHz or GHz, the value is always displayed in GHz.
- a sweep time parameter may be ended in either seconds (Sec) or milliseconds (mS), the value is always displayed in seconds.
- a power level parameter may be ended in either dB or dBm, the value is always displayed in dBm. The dB terminator pushbutton allows the displayed power level parameter to be either added to or subtracted from in dB's. When the dB terminator is used, the sweep generator performs the calculations that convert the output power to a value in dBm. Example 4 in Figure 3-3 shows the use of the dB terminator pushbutton.

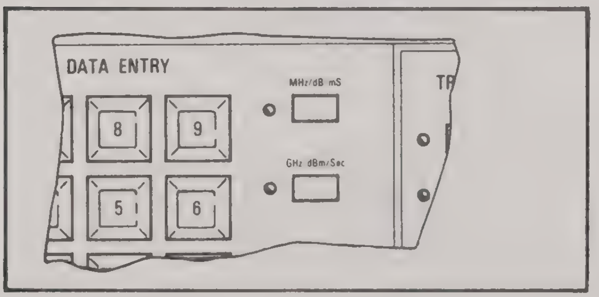


Figure 3-7. MHz/dB/mS and GHz/dBm/Sec (Terminator) Pushbuttons

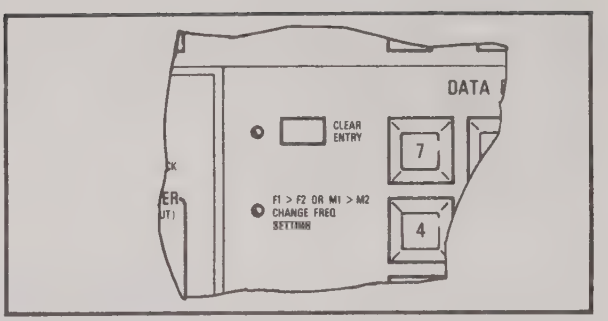


Figure 3-8. CLEAR ENTRY Pushbutton and F1>F2 OR M1>M2 Indicator

e. CLEAR ENTRY Pushbutton and Indicator and F1>F2 OR M1>M2 CHANGE FREQUENCY SETTING Indicator (Figure 3-8).

1. The CLEAR ENTRY pushbutton clears the keypad of an illegal or incomplete data entry (described below), and allows a new value to be entered.
2. The CLEAR ENTRY indicator flashes when an illegal or incomplete data entry has been attempted. (In addition, an illegal entry causes the LED readout displaying the illegal entry to flash; an incomplete entry causes both data terminator pushbutton indicators (Figure 3-7) to flash.)
3. The F1>F2 OR M1>M2 CHANGE FREQ SETTING indicator, along with the two LED readouts displaying frequency, flashes when a "backward" sweep is attempted. A backward sweep is when the respective value of F2 or M2 is less than that of F1 or M1. To clear a backward sweep, either re-enter the frequency values so that F1 or M1 is less than F2 or M2 or select a different frequency range.

An illegal entry is one in which a frequency, sweep time, or output-power level value beyond the range of the sweep generator is entered via the keypad. When this occurs, the CLEAR ENTRY pushbutton must be used to clear the keypad before the error can be corrected.

An incomplete entry is one in which a parameter value is entered on the keypad and the entry is not terminated with a terminator pushbutton (Figure 3-7). When this occurs, the error can be corrected by pressing the appropriate terminator pushbutton or by pressing the CLEAR ENTRY pushbutton and re-entering the data.

f. SHIFT Pushbutton (Figure 3-9). Provides additional functions, designated by blue lettering, for the pushbuttons described below. When SHIFT is pressed, the numeric displays and LED indicators will go out, except for the currently active SHIFT functions. Pressing SHIFT again returns the displays and indicators to their unshifted (normal) indications – no parameters are changed.

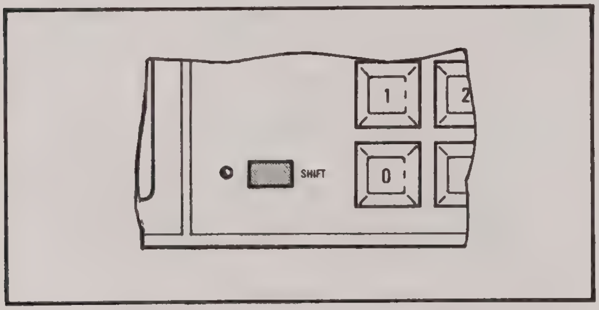


Figure 3-9. SHIFT Pushbutton

1. ALT Pushbuttons (Figure 3-10). Cause the RF output to alternate between any two of the five available sweep ranges (FULL, F1-F2, M1-M2, ΔF F0, ΔF F1). The two sweeps (A and B) are selected, and their start/stop parameters set, in the normal manner (paragraph 3-2.2a). The A (primary) sweep is chosen first, the SHIFT pushbutton is pressed, then the B (alternating) sweep is chosen. After the B sweep is chosen, the numeric displays and LED indicators will return to their unshifted state; the LED indicators associated with the A and B sweep ranges will alternately flash on and off.

When using the alternating sweeps, the following apply:

(a) Frequency markers (VIDEO, RF, and INT) are available and can be set or changed while an alternating sweep is in progress. Marker frequencies can be set on either network analyzer trace. A marker frequency that is changed on one trace will dynamically move to the correct frequency point on the other trace.

(b) When the INCREASE/DECREASE lever is used, it temporarily halts sweep alternations and leaves the A sweep displayed on the network analyzer or oscilloscope. When the lever is released, sweep alternations resume.

(c) If the A or B (or both) sweep is to be a CW frequency, select a ΔF mode and set the ΔF frequency for 0 MHz.

(d) Neither an external nor a manual sweep can be used with an ALT sweep mode. If EXT SWEEP or MANUAL SWEEP has been selected, the microprocessor will ignore any attempt to select an ALT sweep. Conversely, if an ALT sweep has been selected, the microprocessor will ignore attemps to select EXT SWEEP or MANUAL SWEEP.

To exit the alternating sweep mode, press any frequency range pushbutton (including CW).

2. CW FILTER Pushbutton (Figure 3-11). Provides enable/disable, conditional-in/unconditional-out control over the CW filter located in the YIG oscillator tuning circuit. When enabled (LED on), this pushbutton causes the CW filter to be switched-in for CW and narrow (≤50 MHz) sweep modes, and

not inserted otherwise. Conversely, when CW FILTER is disabled (LED off), it causes the CW filter to be unconditionally switched-out of the YIG tuning circuit. CW FILTER is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing CW FILTER, the front panel will automatically return to its unshifted (normal) state. RESET (default) state: Enabled (On).

NOTE

The CW FILTER pushbutton becomes disabled (LED off) when an alternating (ALT) sweep mode is selected. When the ALT mode is exited, the CW FILTER pushbutton resumes its previously selected state.

3. CW RAMP Pushbutton (Figure 3-11). Provides a 0-10V HORIZ OUTPUT sweep ramp for all CW modes (CW F0, CW F1, CW F2, etc.). This pushbutton should be activated (LED on) when the sweep generator is used with a Model 560 or 560A Scalar Network Analyzer; otherwise, the pushbutton should be off. CW RAMP is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing CW RAMP, the front panel will automatically return to its unshifted (normal) state. RESET (default) state: Off.

4. EXT SWEEP Pushbutton (Figure 3-14). Provides for sweeping the output frequency using an external sweep ramp, which is supplied via the rear panel EXT SWEEP connector. EXT SWEEP is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing EXT SWEEP, the front panel will automatically return to its unshifted (normal) state. Pressing any other TRIGGER pushbutton will deactivate EXT SWEEP. RESET (default) state: Off.

3-2.2 FREQUENCY RANGE Pushbuttons

The FREQUENCY RANGE pushbuttons are used to

- select the sweep generator's operational mode – either sweep or CW;
- apply fine-frequency vernier corrections to output frequency in the selected CW mode or to center frequency in the selected ΔF sweep mode;
- apply frequency modulation to or phase-lock control over output frequency in the selected CW output mode.

Individual FREQUENCY RANGE pushbuttons are described below.

a. FULL, F1-F2, M1-M2, ΔF F0, and ΔF F1 Pushbuttons (Figure 3-10). These pushbuttons select the sweep mode as follows:

FULL: Selects a mode in which the frequency sweep is from the sweep generator's lower to its upper frequency limit. When FULL is engaged, its indicator lights, the lower frequency limit appears on the F1-F0-M1 LED readout, and the upper frequency limit appears on the F2-ΔF-M2 LED readout. RESET (default) state: On.

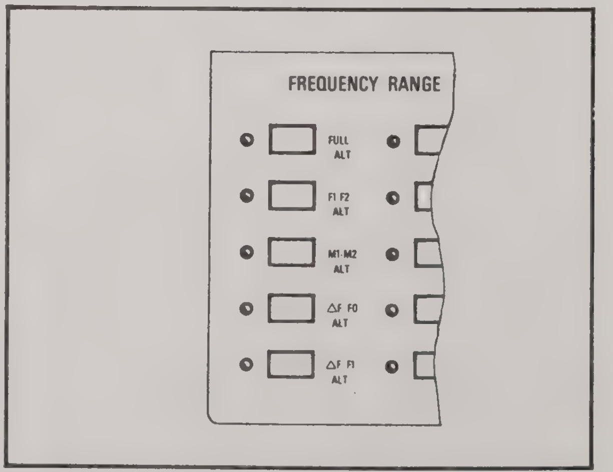


Figure 3-10. FULL, F1-F2, M1-M2, ΔF F0, ΔF F1 Pushbuttons

F1-F2: Selects a mode in which the frequency sweep is from F1 to F2. When F1-F2 is engaged, its indicator lights, the F1 frequency appears on the F1-F0-M1 LED readout, and the F2 frequency appears on the F2-ΔF-M2 LED readout.

M1-M2: Selects a mode in which the frequency sweep is from M1 to M2. When M1-M2 is engaged, its indicator lights, the M1 frequency appears on the F1-F0-M1 LED readout, and the M2 frequency appears on the F2-ΔF-M2 LED readout.

ΔF F0: Selects a mode in which the frequency sweep is symmetrical about the F0 frequency. The width of this sweep, though usually narrow-band, can go from 0 to 100% of the full frequency range. When ΔF F0 is engaged, its indicator lights, the F0 frequency appears on the F1-F0-M1 LED readout, and the ΔF Frequency appears on the F2-ΔF-M2 LED readout.

NOTE

The ΔF F0 and ΔF F1 sweeps can be asymmetrical. Asymmetry will occur when one-half the width of the ΔF sweep will cause the band-edge at either end of the frequency band to be exceeded. The sweep generator cannot sweep beyond its band-edges. (It will sweep only to the band-edge on one side of F0 (or F1) and up to one-half the ΔF sweep on the other side.)

ΔF F1: Selects a mode in which the frequency sweep is symmetrical about the F1 frequency. The width of this sweep and the frequency readouts are as described for ΔF F0, above.

The FULL, F1-F2, M1-M2, etc. controls are interlocked with the CW control group (subparagraph b, below) so that only one control can be engaged at any one time.

b. CW F0, CW F1, CW F2, CW M1, and CW M2 Pushbuttons (Figure 3-11).

These pushbuttons select a CW frequency mode, as follows:

CW F0: Selects a mode in which the CW frequency is at F0. When CW F0 is engaged, its indicator lights, and the F0 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW F1: Selects a mode in which the CW frequency is at F1. When CW F1 is engaged, its indicator lights, and the F1 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW F2: Selects a mode in which the CW frequency is at F2. When CW F2 is engaged, its indicator lights, and the F2 frequency appears on the F2-ΔF-M2 LED readout. The LED readout above F1-F0-M1 is blanked out.

CW M1: Selects a mode in which the CW frequency is at M1. When CW M1 is engaged, its indicator lights, and the M1 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW M2: Selects a mode in which the CW frequency is at M2. When CW M2 is engaged, its indicator lights and the M2 frequency appears on the F2-ΔF-M2 LED readout. The LED readout above F1-F0-M1 is blanked out.

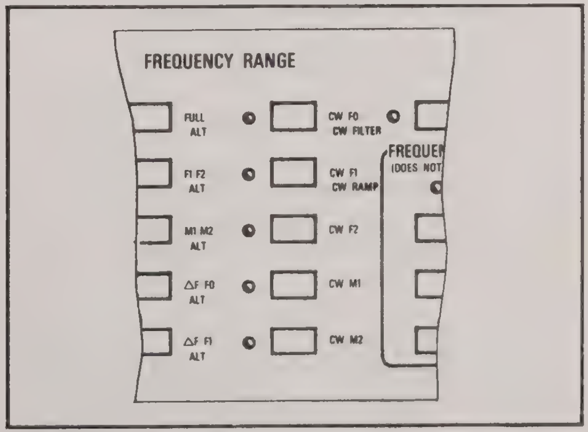


Figure 3-11. CW F0, CW F1, CW F2, CW M1/ and CW M2 Pushbuttons

c. FREQUENCY VERNIER Pushbuttons (Figure 3-12). These pushbuttons may be used to make fine adjustments to (1) output frequency in the selected CW mode or (2) center frequency in the selected ΔF mode. The frequency resolution achievable using these pushbuttons is ±100 kHz for all models except the 6642A, 6653A, and 6659A. For these three models, resolution is ±200 kHz. Individual pushbuttons are described below.

INCREASE: Increases by a maximum of 12.7 MHz (25 MHz for Models 6642A, 6653A and 6659A) the value of selected CW output or ΔF center frequency. The LED readout value of the selected CW or ΔF frequency is not affected by this control.

DECREASE: Decreases by a maximum of 12.7 MHz (25 MHz for Models 6642A, 6653A and 6659A) the value of the selected CW output or ΔF center frequency. The LED readout value of the selected CW or ΔF frequency is not affected by this control.

OFF: Cancels the vernier correction being applied to the selected CW output or ΔF center frequency and turns the ACTIVE indicator OFF in that mode.

NOTE

> A different vernier correction value can be entered for each of the five frequency parameters (F0, F1, F2, M1, M2). Once made, the vernier correction is stored in memory with the parameter and remains in effect even when the sweep generator has been turned off. Pressing the OFF pushbutton or changing the frequency value of a parameter cancels the vernier correction.

d. FM AND PHASELOCK Pushbutton (Figure 3-13). This pushbutton allows the sweep generator output frequency to be either frequency-modulated or phase-locked to an external frequency standard. The external FM or phase-lock signal is input via the rear panel EXT FM Ø LOCK INPUT connector.

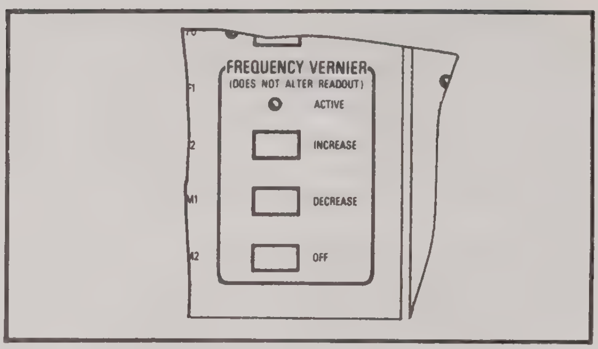


Figure 3-12. FREQUENCY VERNIER Controls

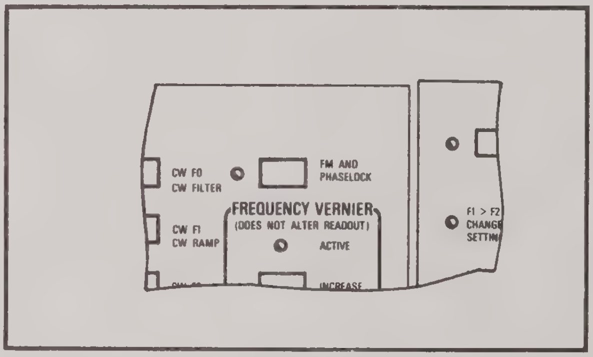


Figure 3-13. FM AND PHASELOCK Pushbutton

3-2.3 TRIGGER Pushbuttons

The TRIGGER pushbuttons (Figure 3-14) select a trigger mode for the frequency sweep. These pushbuttons are interlocked so that only one may be selected at a time. A description of each pushbutton follows:

AUTO: Selects a mode in which the sweep recurs periodically with a minimum delay (hold-off) time between sweeps. RESET (default) state: On.

LINE: Selects a mode in which the sweep recurs at a multiple or submultiple of the line frequency.

EXT OR SINGLE: Selects a mode in which the sweep recurs only when internally or externally triggered. External

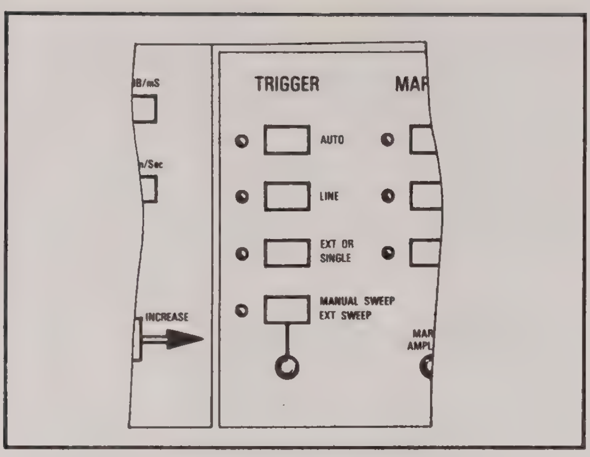


Figure 3-14. TRIGGER Pushbuttons

triggering is via the rear panel EXT TRIGGER INPUT connector; internal triggering is via this pushbutton. When the pushbutton is first pressed, the mode is selected. When the pushbutton is next pressed, the sweep is triggered. And, if the pushbutton is pressed again while the sweep is in progress, the sweep is aborted and reset.

MANUAL SWEEP: Selects a mode in which the frequency band is manually tuned. Manual tuning is provided by the associated control.

3-2.4 MARKERS Pushbuttons

There are three markers (M1, M2, F0) available with the sweep generator. Marker frequency is selected using the DATA ENTRY keypad (paragraph 3-2.1) or the RESET pushbutton (paragraph 3-2.7) – the keypad provides user selection, and the pushbutton provides preset selection. Marker type is selected using the MARKERS pushbuttons (Figure 3-15). The number of markers (1, 2, or 3) that occur when pressing a MARKERS pushbutton depends on which sweep mode has been selected: for FULL, F1-F2, and ΔF F1, all three markers occur; for ΔF F0, markers M1 and M2 occur; and for M1-M2, marker F0 occurs.

To determine which marker frequency (M1, M2, or F0) is being observed on a CRT display, press the M1, M2, and F0 pushbuttons while observing the display. The marker will disappear from the display when the corresponding pushbutton is pressed.

The MARKERS pushbuttons are described below. These pushbuttons are interlocked in such a way that all three may be off, but only one may be on at a time.

VIDEO: Causes a positive-video pulse to occur at the marker frequency(ies). The amplitude of this pulse can be adjusted from 0 to +5 volts using the MARKER AMPLITUDE control. RESET (default) state: On.

RF: Causes a negative RF pip to occur at the marker frequency(ies). The amplitude of this pip can be adjusted between 0 and approximately 10 dB using the MARKER AMPLITUDE control.

INTENSITY: Causes an intensity dot to occur at the marker frequency(ies). The intensity marker is created by causing the sweep to dwell at the marker frequency(ies). No connection is required between the sweep generator and a CRT Z-axis input. The intensity of this marker is not affected by the MARKER AMPLITUDE control.

NOTE

For the intensity marker to be used with the Model 560/560A Scalar Network Analyzer, the network analyzer must be in the REAL TIME display mode.

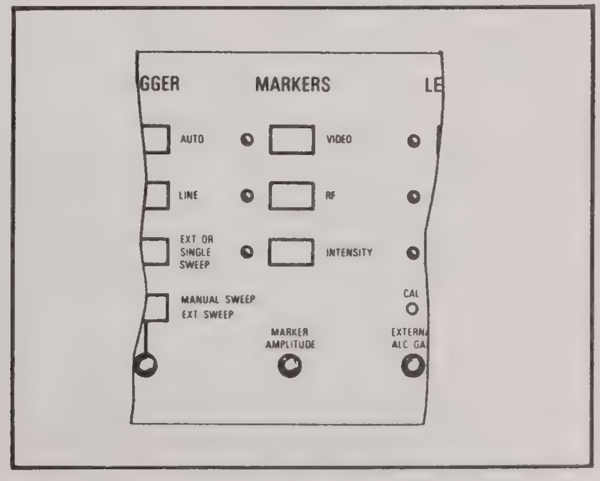


Figure 3-15. MARKERS Pushbuttons

3-2.5 LEVELING Controls

The LEVELING controls (Figure 3-16) select the type of leveling to be employed. These controls are interlocked so that all three pushbuttons may be off, but only one pushbutton may be on at a time. A description of each pushbutton follows.

INTERNAL: Selects an internally mounted directional detector for use in leveling the output power. When this pushbutton is engaged, the output power is sampled at the front-panel connector and fed back for leveling control. Internal leveling is not available for the 26.5-40 GHz band on the 6642A. RESET (default) state: On.

DETECTOR: Allows an external directional coupler and either a positive or a negative detector to be used in leveling the output power. When this pushbutton is engaged, the output power may be sampled at the end of the transmission line and fed back for leveling control.

POWER METER: Allows an external power meter, with either a positive or a negative recorder output voltage, to be used in leveling the output power. When this pushbutton is engaged, the output power may be sampled at the end of the transmission line and fed back for leveling control.

The sweep generator is compatible with power meters having a ±1V FS analog output, such as the HP 431/432, HP 435/436, and PM 1009/1010 models.

EXTERNAL ALC GAIN: Adjusts the gain of the signal applied to the EXTERNAL INPUT connector. The control's calibrate function automatically indicates when the gain is adjusted correctly for optimum ALC operation. To use this function, push in and turn the control until the CAL indicator comes on and stays on continuously. The indicator goes out when the control is released to its normal position.

NOTE

> The PUSH TO CAL function is not operative for the 26.5-40 GHz band on the 6642A.

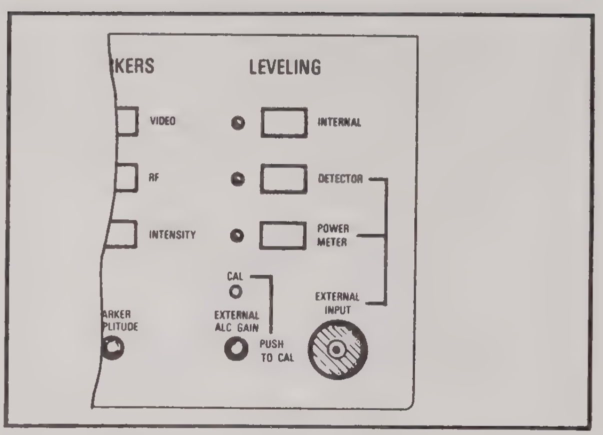


Figure 3-16. LEVELING Controls

3-2.6 RF OUTPUT Controls, Indicators, and Connector

The RF OUTPUT controls, indicators, and connector (Figure 3-17) are described below.

RF ON (Pushbutton): Turns the RF output on and off. RESET (default) state: On.

RETRACE RF (Pushbutton): Turns the RF output on and off during sweep retrace. This control is interlocked with the RF ON control so that it cannot be turned on unless the RF ON control is on, but it can be turned off independently of the RF ON control.

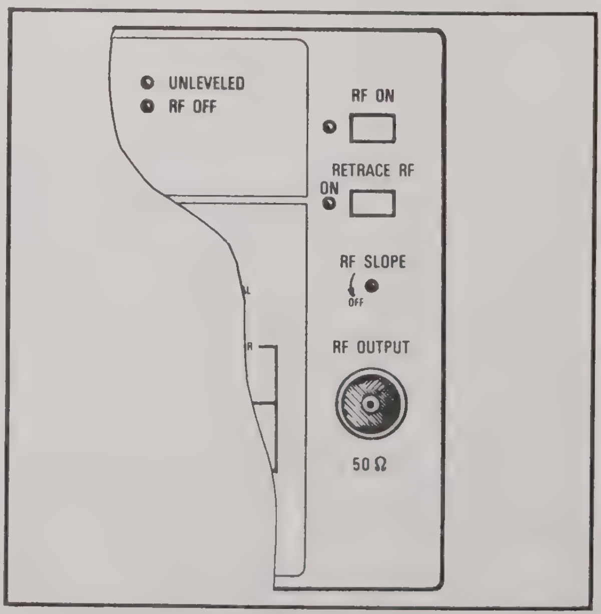


Figure 3-17. RF OUTPUT Controls

RF SLOPE (Control): Clockwise rotation adjusts the slope of the detected, leveled RF output signal. The control is used to compensate for the linear-with-frequency attenuation characteristics of RF transmission lines, when such lines are used with swept-frequency measurements. The OFF position provides optimum flatness at the RF OUTPUT connector.

UNLEVELED (Indicator): Lights when the RF output is unleveled.

RF OFF (Indicator): Flashes when the RF output is off.

RF OUTPUT (Connector): Provides RF output from 50Ω source. To prevent RF losses due to impedance mismatch, the mating connector and cable should have a 50Ω impedance rating.

3-2.7 POWER, SELF TEST, and RESET Controls

These controls (Figure 3-18) are described below.

POWER: Turns ac power on and off. When power is turned on, the A12 Microprocessor PCB software-version number (e.g. 1.7) appears on the F1-F0-M1 LED and a self test is initiated.

SELF TEST: Initiates self testing of sweep-generator circuits. Paragraph 3-4 describes the self-test feature.

RESET: Presets the front panel controls as shown below and numeric parameters as shown in Table 3-1.

Front Panel Controls

FREQUENCY RANGE: FULL (upper and lower frequency limits are displayed).
TRIGGER: AUTO
MARKERS: Off
LEVELING: INTERNAL
RF ON: On

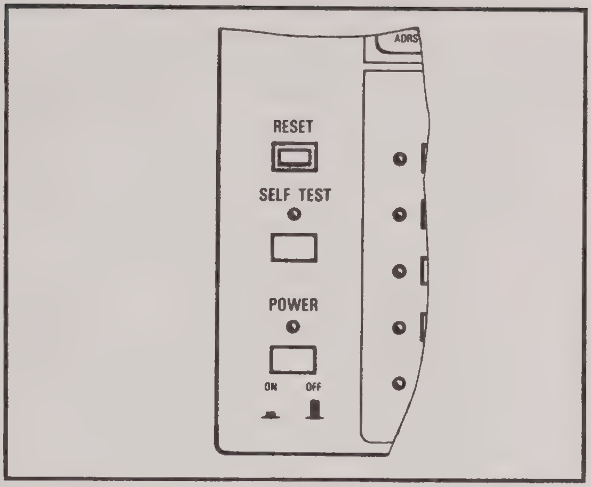


Figure 3-18. POWER, SELF TEST, and RESET Controls

3-2.8 BUS ADRS/RETURN TO LOCAL Control and GPIB Indicators

The BUS ADRS/RETURN TO LOCAL pushbutton and the REMOTE, LOCAL LOCKOUT, TALK, LISTEN, and SRQ GPIB indicators (Figure 3-19) are described below.

BUS ADRS/RETURN TO LOCAL (Pushbutton): In the local (front panel) mode, the pushbutton causes the bus address to be displayed on the SWEEP TIME-LEVEL LED readout. In the remote (GPIB) mode, provided that a local lockout bus message is not programmed, the pushbutton causes the sweep generator to return to the local mode.

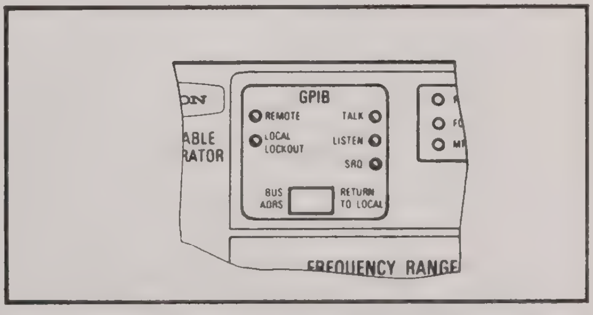


Figure 3-19. BUS ADRS/RETURN TO LOCAL Control and GPIB Indicators

Table 3-1. Reset (Default) Setting for Numeric Parameters

All Models:
SWEEP TIME: 50 ms
LEVEL: Maximum Leveled Power (Table 1-1)
ΔF: 1000 Hz

Model: 6609A

F1: 10 MHz
F2: 2000 MHz
F0: 1000 MHz
M1: 500 MHz
M2: 1500 MHz

Model: 6617A

F1: 10 MHz
F2: 8000 MHz
F0: 4000 MHz
M1: 3000 MHz
M2: 7000 MHz

Model: 6621A

F1: 2000 MHz
F2: 12000 MHz
F0: 9000 MHz
M1: 3000 MHz
M2: 11000 MHz

Model: 6621A-40

F1: 2000 MHz
F2: 12000 MHz
F0: 9000 MHz
M1: 3000 MHz
M2: 11000 MHz

Model: 6629A

F1: 8000 MHz
F2: 18000 MHz
F0: 13000 MHz
M1: 9000 MHz
M2: 17000 MHz

Model: 6629A-40

F1: 8000 MHz
F2: 18000 MHz
F0: 13000 MHz
M1: 9000 MHz
M2: 17000 MHz

Model: 6637A

F1: 2000 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 17000 MHz

Model: 6637A-40

F1: 2000 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 17000 MHz

Model: 6638A

F1: 2000 MHz
F2: 20000 MHz
F0: 11000 MHz
M1: 3000 MHz
M2: 19000 MHz

Model: 6642A

F1: 18000 MHz
F2: 40000 MHz
F0: 25000 MHz
M1: 19000 MHz
M2: 39000 MHz

Model: 6647A

F1: 10 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 1000 MHz
M2: 17000 MHz

Model: 6648A

F1: 10 MHz
F2: 20000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 19000 MHz

Model: 6653A

F1: 2000 MHz
F2: 26000 MHz
F0: 14000 MHz
M1: 3000 MHz
M2: 25000 MHz

Model: 6659A

F1: 10 MHz
F2: 26000 MHz
F0: 14000 MHz
M1: 3000 MHz
M2: 25000 MHz

REMOTE (Indicator): Lights when sweep generator goes under GPIB control. Remains lit until sweep generator is returned to local control.

LOCAL LOCKOUT (Indicator): Lights when sweep generator receives a local lockout message; remains lit until local lockout message is rescinded. When LOCAL LOCKOUT indicator is lit, sweep generator cannot be returned to local control via the front panel.

TALK (Indicator): Lights when sweep generator is addressed to talk; remains lit until unaddressed.

LISTEN (Indicator): Lights when sweep generator is addressed to listen; remains lit until unaddressed.

SRQ (Indicator): Lights when sweep generator sends a Service Request; remains lit until a serial poll is received or the SRQ function is reset (paragraph 3-7.4).

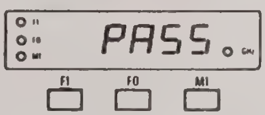
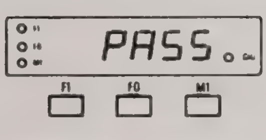
3-3 REAR PANEL CONTROLS AND CONNECTORS

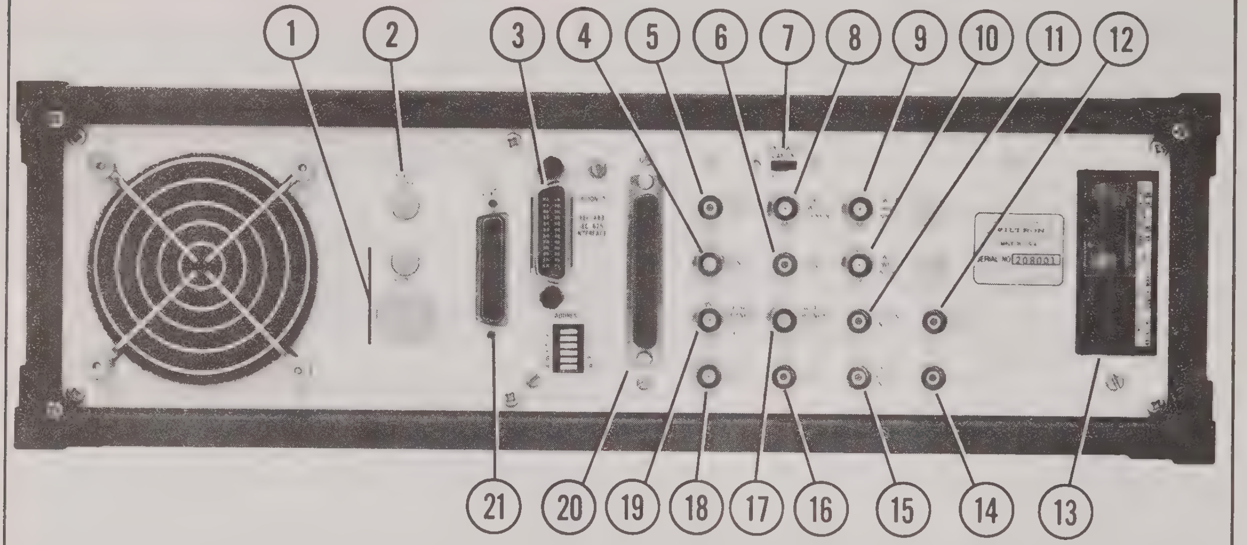
The rear panel controls and connectors are described in Figure 3-20.

3-4 SELF-TEST FEATURES

The sweep generator is equipped with a self-test feature that uses an internal microprocessor to test (1) selected circuits on each of the printed circuit boards and (2) all of the indicators and LED displays on the front panel. There are three ways in which a self-test is initiated. And, if an error is detected, there are up to 25 error codes that may be displayed on the front panel. The three ways in which a self test is initiated are described in Table 3-2; the error codes are described in Table 3-3.

Table 3-2. Three Ways in Which Self-Test is Initiated

How Self Test Is Initiated	Indication If Self Test Passes	Indication If Self Test Fails
1. Pressing POWER pushbutton to ON.		An error code number between 00 and 24 is displayed above the F2-ΔF-M2 group of pushbuttons (Table 3-3).
2. Pressing SELF TEST.	a. All front panel indicators and LED displays are tested. (Indicators and displays light and remain lit 5 seconds.) and b. 	Same as above.
3. Sending sweep generator TST command over the bus (Option 3).	a. Numeric LED readouts are blanked. b. The ASCII character "P" is sent over the bus to the controller.	a. Numeric LED readouts are blanked. b. The ASCII character "F" is sent over the bus to the controller.



① **Main RF OUTPUT Connector (Option 9):** Provides 50-ohm RF output. (Not available on 6642A above 26.5 GHz.)

② **Auxiliary RF OUTPUT Connector** (Option 10): Provides 50-ohm RF output. Output power is attenuated by ≈25 dB from the power available at the main RF OUTPUT connector.

③ **IEEE-488 Interface Bus Connector** (Option 3): Provides input output connections to General Purpose Interface Bus (GPIB).

④ **SEQ SYNC OUTPUT:** Provides a positive pulse during sweep retrace, and when the RF plug-in switches between different YIG oscillators (bandswitches). Signal is used to supply retrace information to the WILTRON Model 560/560A and HP Model 8410 Network Analyzers. Connects to FROM SEQ SYNC WILTRON connector on Model 560 or to Z-AXIS SELECT on Model 560A.

⑤ **HORIZ OUTPUT:** Provides 0 to 10 volts during all sweep modes, and during all CW modes when CW RAMP is activated. Connects to HORIZ INPUT (HORIZONTAL INPUT on 560A) connector on Model 560 Scalar Network Analyzer.

⑥ **1V/GHz OUTPUT:** Provides voltage signal equal to 1V per GHz for all models except the 6642A, 6653A, and 6659A. For these three models, the signal is 0.5V per GHz. Signal may be used as an approximate frequency reference and also for tuning the HP 8410B Network Analyzer.

⑦ **BANDSWITCH BLANKING (+, -):** Switches BANDSWITCH BLANKING signal either plus or minus.

⑧ **BANDSWITCH BLANKING:** Provides + or -5V pulse, depending on BANDSWITCH BLANKING switch, during RF oscillator bandswitching. ±5V pulse may be used to blank sweep generator bandswitch points on oscilloscope display.

Figure 3-20. Rear Panel Controls and Connectors

⑨ **SWEEP TRIGGER INPUT:** Provides for external sweep triggering when TRIGGER-EXT OR SINGLE pushbutton is engaged. Trigger occurs on closure-to-ground. To provide for proper triggering, the input pulse should be a clock pulse with the following characteristics:

Amplitude: 4 to 25 Vpk
Pulse Width: >1μs
Fall Time: <5μs
Polarity: Low true

⑩ **SWEEP DWELL INPUT:** Allows a pulse from the HP 8410 Network Analyzer to cause the sweep generator sweep to dwell during 8410 sweep retrace.

⑪ **EXT AM INPUT:** Provides for applying amplitude modulation to the RF output signal. The frequency of the modulating signal can go from dc to 50 kHz. Input impedance is 10 kilohms.

⑫ **EXT SQ WAVE INPUT:** Provides for applying square-wave modulation to the RF output signal. The input square wave can have a frequency of up to 50 kHz and an amplitude of ±10 volts. Input impedance is TTL compatible. (Not available on 6642A.)

⑬ **Voltage Selector Module:** Allows 100, 115-120, 220, or 230-240 Vac line voltage values to be used with sweep generator. Refer to paragraph 2-3 for setup instructions.

⑭ **EXT SWEEP:** Allows an external 0 to 10 volt ramp to be used to sweep the output frequency. To use this input, the EXT SWEEP pushbutton must be activated.

⑮ **EXT FM Ø LOCK INPUT:** Provides for applying frequency modulation and phase-lock control (paragraph 3-2.2d) to the RF output signal.

⑯ **PENLIFT OUTPUT:** Provides isolated, normally-open relay contacts for lifting recorder pen during sweep retrace. Can be modified internally for normally-closed relay contact operation.

⑰ **RETRACE BLANKING OUTPUT (–):** Provides -5V pulse during sweep retrace.

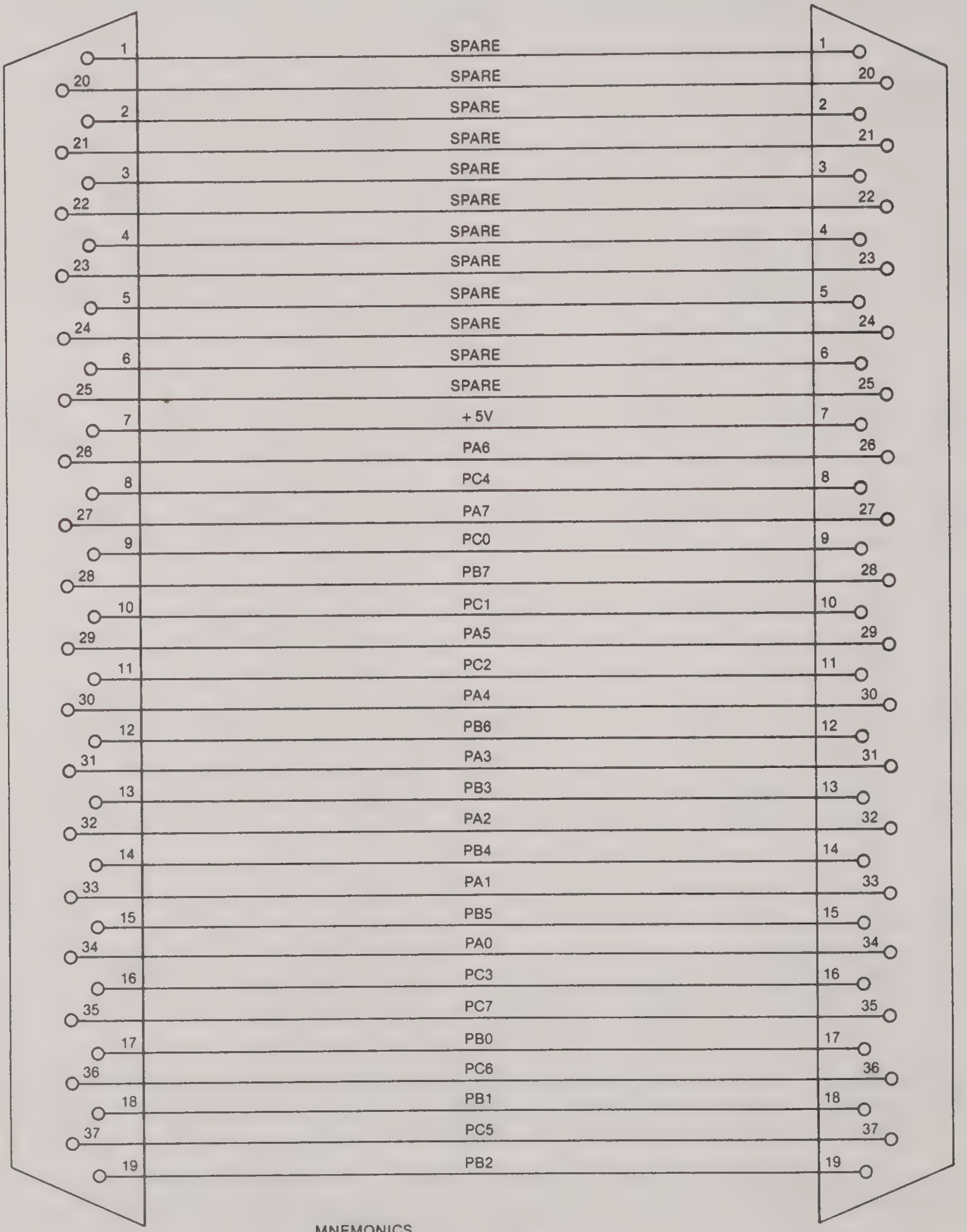
⑱ **MARKER OUTPUT:** Provides video marker output when MARKERS-VIDEO pushbutton is engaged. Connects to MARKER INPUT connector on Model 560/560A Scalar Network Analyzer.

⑲ **RETRACE BLANKING OUTPUT (+):** Provides +5V pulse during sweep retrace. Connects to FROM BLANKING (+) WILTRON connector on WILTRON Model 560/560A Scalar Network Analyzer.

⑳ **DATA I/O** (Option 14): 37-pin connector providing interface between the Model 661 Tracking Sweeper Controller and the GPIB. Connects with DATA I/O port on 661. See Figure 3-21 for a pinout diagram.

㉑ **AUX I/O:** 25-pin connector providing interface between the sweep generator and the Model 661 Tracking Sweeper Controller or Model 560A Scalar Network Analyzer. See Figure 3-22 for a pinout diagram.

Figure 3-20. Rear Panel Controls and Connectors (Continued)


1 SPARE 1
20 SPARE 20
2 SPARE 2
21 SPARE 21
3 SPARE 3
22 SPARE 22
4 SPARE 4
23 SPARE 23
5 SPARE 5
24 SPARE 24
6 SPARE 6
25 SPARE 25
7 +5V 7
26 PA6 26
8 PC4 8
27 PA7 27
9 PC0 9
28 PB7 28
10 PC1 10
29 PA5 29
11 PC2 11
30 PA4 30
12 PB6 12
31 PA3 31
13 PB3 13
32 PA2 32
14 PB4 14
33 PA1 33
15 PB5 15
34 PA0 34
16 PC3 16
35 PC7 35
17 PB0 17
36 PC6 36
18 PB1 18
37 PC5 37
19 PB2 19

MNEMONICS
PA, PB, PC refer to IC A1U1 ports A, B, & C.
Digits refer to bit numbers.

Figure 3-21. Pinout Diagram, DATA I/O Interconnect Cable

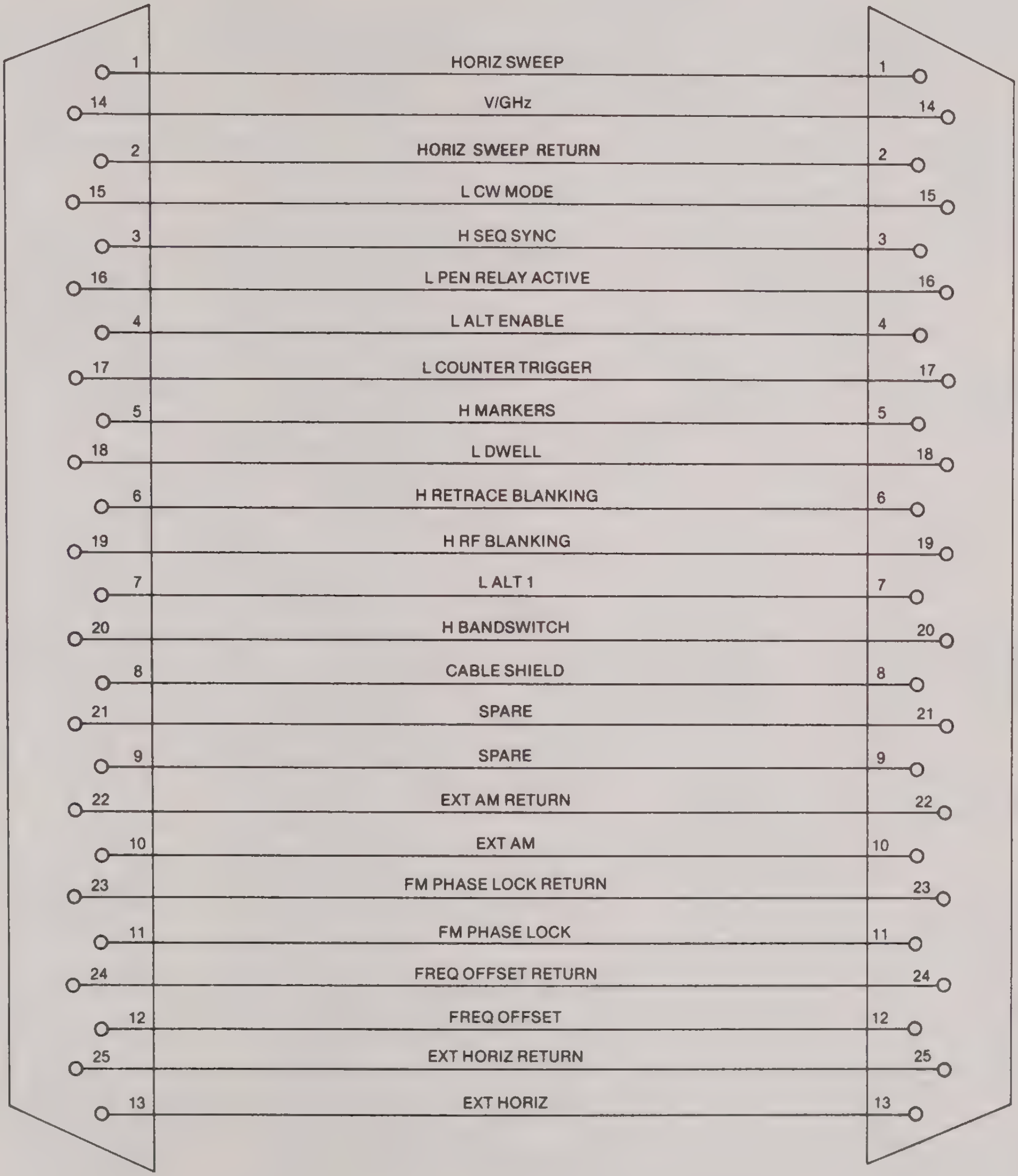
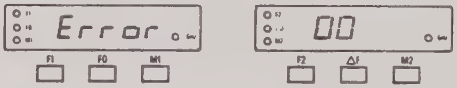
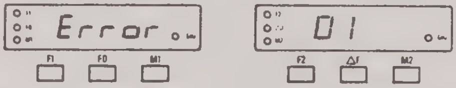
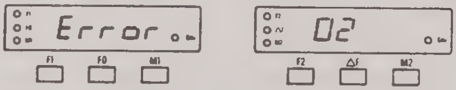
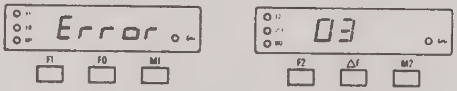
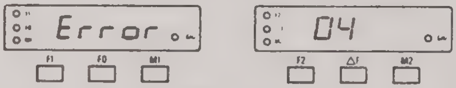
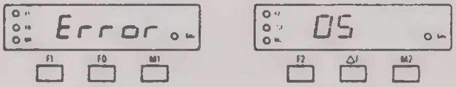
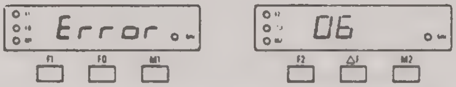
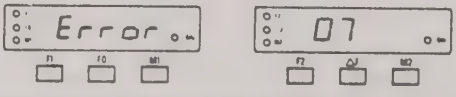
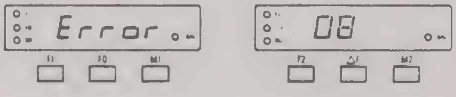
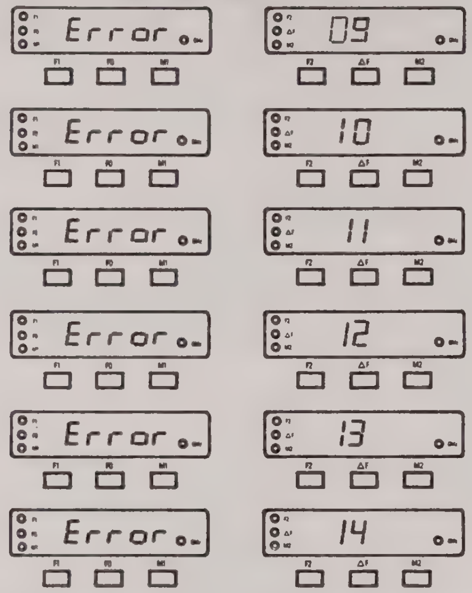
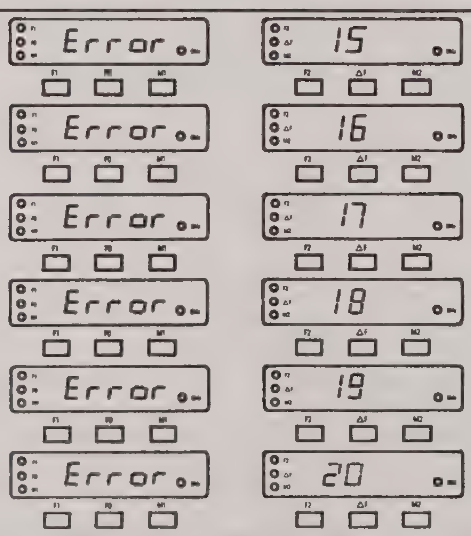
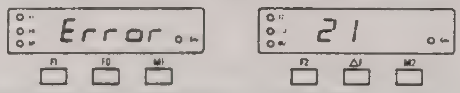
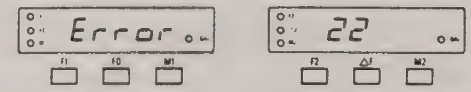
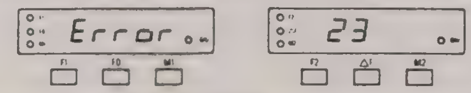

1 HORIZ SWEEP 1
14 V/GHz 14
2 HORIZ SWEEP RETURN 2
15 L CW MODE 15
3 H SEQ SYNC 3
16 L PEN RELAY ACTIVE 16
4 L ALT ENABLE 4
17 L COUNTER TRIGGER 17
5 H MARKERS 5
18 L DWELL 18
6 H RETRACE BLANKING 6
19 H RF BLANKING 19
7 L ALT 1 7
20 H BANDSWITCH 20
8 CABLE SHIELD 8
21 SPARE 21
9 SPARE 9
22 EXT AM RETURN 22
10 EXT AM 10
23 FM PHASE LOCK RETURN 23
11 FM PHASE LOCK 11
24 FREQ OFFSET RETURN 24
12 FREQ OFFSET 12
25 EXT HORIZ RETURN 25
13 EXT HORIZ 13

Figure 3-22. Pinout Diagram, AUX I/O Interconnect Cable

Table 3-3. Self-Test Error Codes

GENERAL: The microprocessor's self-test routines reside in software modules; each module is assigned an error-code number. When a self-test is initiated, these software modules are called up in sequential order, beginning with number 00 and ending with number 24. If an error is detected, the error-code number is displayed and the self-test continues. If multiple errors are detected, each error-code number is displayed. To abort self-test once it has begun, press the RESET pushbutton.

SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
 Error F1 F0 M1 00 F2 ΔF M2	A voltage supply other than the 5V supply is out of tolerance. If the 5V supply is faulty, the sweep generator will not operate.	See Figure 7-127 for troubleshooting flowchart.
 Error F1 F0 M1 01 F2 ΔF M2	Line voltage too low.	See Figure 7-128 for troubleshooting flowchart.
 Error F1 F0 M1 02 F2 ΔF M2	Line voltage too high.	See Figure 7-129 for troubleshooting flowchart.
 Error F1 F0 M1 03 F2 ΔF M2	ROM U5 fails bit parity check.	Replace A12 U5.
 Error F1 F0 M1 04 F2 ΔF M2	ROM U6 fails bit parity check.	Replace A12 U6.
 Error F1 F0 M1 05 F2 ΔF M2	ROM U7 fails bit parity check.	Replace A12 U7.
 Error F1 F0 M1 06 F2 ΔF M2	ROM U8 fails bit parity check.	Replace A12 U8.
 Error F1 F0 M1 07 F2 ΔF M2	ROM U9 fails bit parity check.	Replace A12 U9.
 Error F1 F0 M1 08 F2 ΔF M2	One or more RAMs, U11, U12, U37, U38, fail write verification test.	Replace RAMs.

SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
 Error 09 Error 10 Error 11 Error 12 Error 13 Error 14 F1 F0 M1 F2 ΔF M2	The association of error codes, PCBs, and frequency bands is shown below: Error Code — PCB (Band) 09 — A6 (Het.) 10 — A6 (Osc. 1) 11 — A7 (Osc. 2) 12 — A8 (Osc. 3) 13 — A9 (Osc. 4)	Troubleshooting flowcharts are given below: Error Code — Flowchart 09 — Figure 7-85 10 — Figure 7-86 11 — Figure 7-87 12 — Figure 7-87 13 — Figure 7-87 14 — Figure 7-88
 Error 15 Error 16 Error 17 Error 18 Error 19 Error 20 F1 F0 M1 F2 ΔF M2	The association of error codes and frequency bands is shown below: Error Code — Freq. Band 15 — Het. 16 — Osc. 1 17 — Osc. 2 18 — Osc. 3 19 — Osc. 4 20 — All	See Figure 7-46 for troubleshooting flowcharts.
 Error 21 F1 F0 M1 F2 ΔF M2	Analog circuit error, detected during Ramp Generator (A2) PCB test.	See Figure 7-35 for troubleshooting flowchart.
 Error 22 F1 F0 M1 F2 ΔF M2	Analog circuit error, detected during Marker (A3) PCB test.	See Figure 7-40 for troubleshooting flowchart.
 Error 23 F1 F0 M1 F2 ΔF M2	Analog circuit error, detected during FM Attenuator (A10) PCB test.	See Figure 7-92 for troubleshooting flowchart.

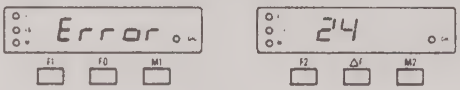
SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
	Only appears if Option 3 installed. Indicates error detected during GPIB Interface (A1) PCB test.	See Figure 7-28 for troubleshooting flowchart.

Table 3-4. Recommended Test Equipment for Operational Checkout

EQUIPMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MANUFACTURER	PURPOSE
Scalar Network Analyzer	Ability to display frequency response of sweep generator.	WILTRON Model 560 Scalar Network Analyzer, with 7N50 Detector or 7S50, Option 2 Detector (6642A)	Display sweep generator output during operational checkout.
Microwave Frequency Counter	.01 to 26.5 GHz frequency response with source locking capability.	EIP Model 578	Used with Table 3-6 to check the operation of the FREQUENCY VERNIER controls and phase-locking capability for all models except 6642A.
Microwave Frequency Counter	26.5 to 40 GHz frequency response with source-locking capability.	EIP Model 578/06 with 590 frequency extension kit and Option 91 Remote Sensor	Used with Table 3-6 to check the operation of the 6642A FREQUENCY VERNIER controls and phase-locking capability.
Directional Coupler	Ability to couple signals within a portion of the 10 MHz to 18 GHz frequency range.	NARDA Model 3202B-10	
RF Detector	Ability to detect signals within the 10 MHz to 18 GHz frequency range.	WILTRON Model 75N50	Used with Table 3-7 to check the operation of external leveling feature.
Power Meter	Ability to provide output signal that is (1) proportional to the measured power and (2) 1 volt for full-scale deflection.	Hewlett-Packard Model 435A with 8481 Power Sensor	
Crystal Detector	26.5 to 40 GHz frequency range	HP R422A	
Power Meter		HP 432A, with R486A Thermistor Mount	Used with Table 3-8 to check the operation of the 6642A external leveling feature.
Adapter Cable for 560	Adapt 560 input to waveguide detector.	WILTRON 560-10BX-1	
Connector Adapters (2)	Adapt between SMA-female and BNC-male connectors.	Pomona Elect. 4290	

3-5 OPERATIONAL CHECKOUT PROCEDURES

The operational checkout procedures for the sweep generator are given in paragraphs 3-5.1, 3-5.2, 3-5.3 and 3-5.4. These procedures are organized by function, so that only those functions being used need to be checked.

Table 3-4 (facing page) gives the recommended test equipment for the four operational checkout procedures (Tables 3-5, 3-6, 3-7, 3-8.)

Notice that the test equipment differs for each checkout procedure. If the recommended test equipment is not available, equipment with equivalent characteristics may be substituted.

3-5.1 Operational Checkout, Sweep Generator Confidence Test

This paragraph provides the confidence test procedure for the sweep generator. Figure 3-23 shows the test setup and Table 3-5 gives the test procedure.

Table 3-5. Sweep Generator Confidence Test (All models except 6642A)

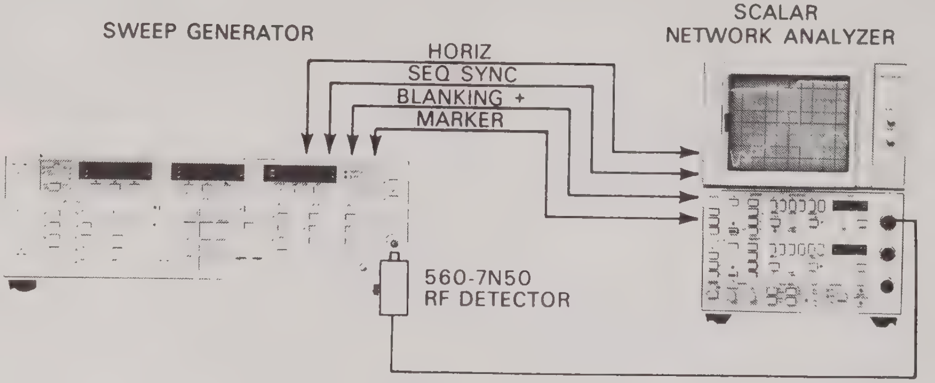
1. Connect the equipment as shown in Figure 3-23.
2. Turn on the sweep generator and press RESET. If no error code appears on the appropriate LED readouts (Table 3-3), the sweep generator should be functioning normally.

NOTE

The digits on the LED displays will be random for the first 1/2-second after turn-on.

3. Observe the 560 CRT. A leveled trace should be located near center screen.
4. Press LEVELING INTERNAL. The 560 trace should go unleveled.
5. Press INTERNAL again. A leveled trace returns to the 560 CRT.
6. Press LEVEL and set for 0 dBm (+3 dBm, 6609A; -5 dBm, 6642A). Verify that the 560 trace "jumps" 2 divisions (10 dB), and that the trace remains level.

END OF CONFIDENCE TEST


SWEEP GENERATOR
HORIZ
SEQ SYNC
BLANKING +
MARKER
SCALAR NETWORK ANALYZER
560-7N50 RF DETECTOR

Initial Control Settings

Sweep Generator

MARKER AMPLITUDE: Fully CW
SLOPE: OFF

Scalar Network Analyzer

CHANNEL A ON: On
INPUT: A
MEMORY: Off
dB PER DIVISION: 5
REFERENCE dB/dBm: dBm
SET (screwdriver pot): Midrange
OFFSET: -00.0

CHANNEL B: Not used
MARKER THRESHOLD: Midrange
REAL TIME: On
SMOOTHING: Off
POWER: ON

Figure 3-23. Equipment Setup for Confidence Test (except 6642A)

3-5.2 Operational Checkout Procedure, FREQUENCY VERNIER Pushbuttons and Phase-Lock Operation

The FREQUENCY VERNIER pushbuttons provide for making small changes to the output frequency in the CW F0 thru CW M2, ΔF F0, and ΔF F1 operational modes. These frequency changes do not affect the readout that appears on the respective frequency's front panel LED display.

The phase-lock operation automatically "locks" the sweep generator's output frequency to the crystal-controlled time-base of the frequency counter. When the EIP 578 Source Locking Counter is used, the phase-lock function allows the sweep generator's frequency to be accurately resolved to 100 kHz for all models except the 6642A, 6653A and 6659A. For these 3 models, resolution is ±200 kHz.

The test setup for operationally checking the FREQUENCY VERNIER controls and phase-lock operation for all models except 6642A is shown in Figure 3-24; the test setup for the 6642A is shown in Figure 3-25; the checkout procedure is given in Table 3-6.

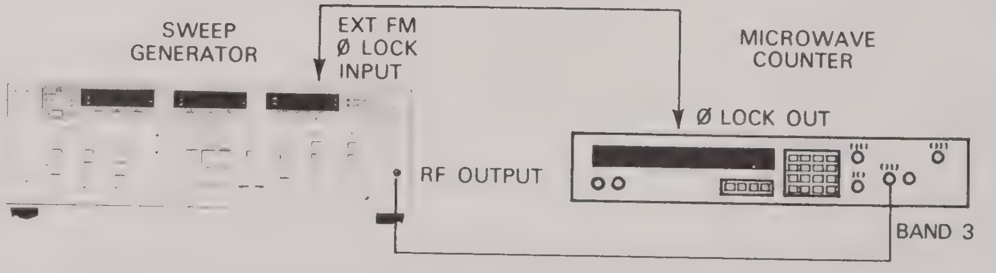

SWEEP GENERATOR
EXT FM
Ø LOCK
INPUT
MICROWAVE COUNTER
Ø LOCK OUT
RF OUTPUT
BAND 3

Figure 3-24. Test Setup for Operational Checkout of FREQUENCY VERNIER Controls (All models except 6642A)

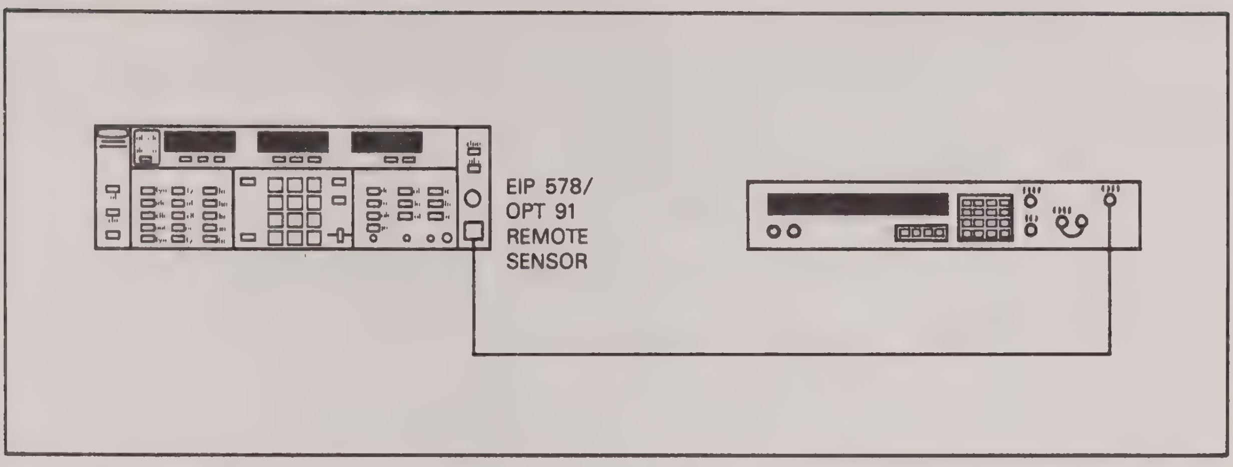


Figure 3-25. Test Equipment Setup for Operational Checkout of FREQUENCY VERNIER Controls on Model 6642A, 26.5-40 GHz Band

Table 3-6. Operational Checkout Procedure, FREQUENCY VERNIER Controls and Phase-Lock Operation (all models)

1. Connect test equipment as shown in Figure 3-24 or 3-25.
2. Turn on power to sweep generator (sweeper) and frequency counter (counter).
3. On sweeper, press LEVEL and set for 0 dBm.
4. Connect 50Ω cable between RF OUTPUT on sweeper and the appropriate BAND input on counter.

Frequency Vernier Controls Operation

5. On sweeper, press CW F0 and set for low-end frequency +50 MHz.
6. Observe counter:
   a. If frequency is below the sweeper-output frequency, press & hold FREQUENCY VERNIER INCREASE until counter frequency equals sweeper frequency.
   b. If frequency is above the sweeper-output frequency, press & hold FREQUENCY VERNIER DECREASE until counter frequency equals sweeper frequency.
7. On sweeper, press CW F2 and set for midband frequency.
8. Repeat step 6 above.
9. On sweeper, press CW M2 and set for high-end frequency -50 MHz.
10. Repeat step 6 above.

Table 3-6. Operational Checkout Procedure, FREQUENCY VERNIER Controls and Phase-Lock Operation (all models) (Continued)

11. Verify that the FREQUENCY VERNIER ACTIVE indicator is lit for each of the parameters receiving a frequency correction, as follows:
    - a. Press CW F0 and verify that ACTIVE indicator is lit.
    - b. Press CW F1 and verify that ACTIVE indicator is not lit.
    - c. Press CW F2 and verify that ACTIVE indicator is lit.
    - d. Press CW M1 and verify that ACTIVE indicator is not lit.
    - e. Press CW M2 and verify that ACTIVE indicator is lit.
    - f. Press ΔF F0 and verify that ACTIVE indicator is lit.
    - g. Press ΔF F1 and verify that ACTIVE indicator is not lit.
12. Verify that frequency-vernier correction is canceled when the parameter to which a vernier correction was applied is changed, as follows:
    - a. Press CW F0 and set for midband frequency.
    - b. Verify that the FREQUENCY VERNIER ACTIVE indicator went out.

Phase-Lock Operation

13. Connect a BNC-to-BNC test cable between Ø LOCK OUT on counter and EXT FM Ø LOCK INPUT on sweeper.
14. On counter, enter a lock frequency within the sweeper's range (use keypad and enter this frequency on the auxiliary (small) display).
15. On sweeper,
    - a. Press CW F1 and set for the "lock" frequency.
    - b. Press FM AND PHASELOCK.
16. On counter, press LOCK.
17. Observe counter; it should indicate the lock frequency ± 1 count.

3-5.3 Operational Checkout Procedure, External Leveling Function (All Models Except 6642A)

External leveling of the RF source is provided by the front panel EXTERNAL INPUT connector and the LEVELING-DETECTOR or -POWER METER pushbutton. A test setup for external leveling is shown in Figure 3-26; the operational checkout procedure is given in Table 3-7.

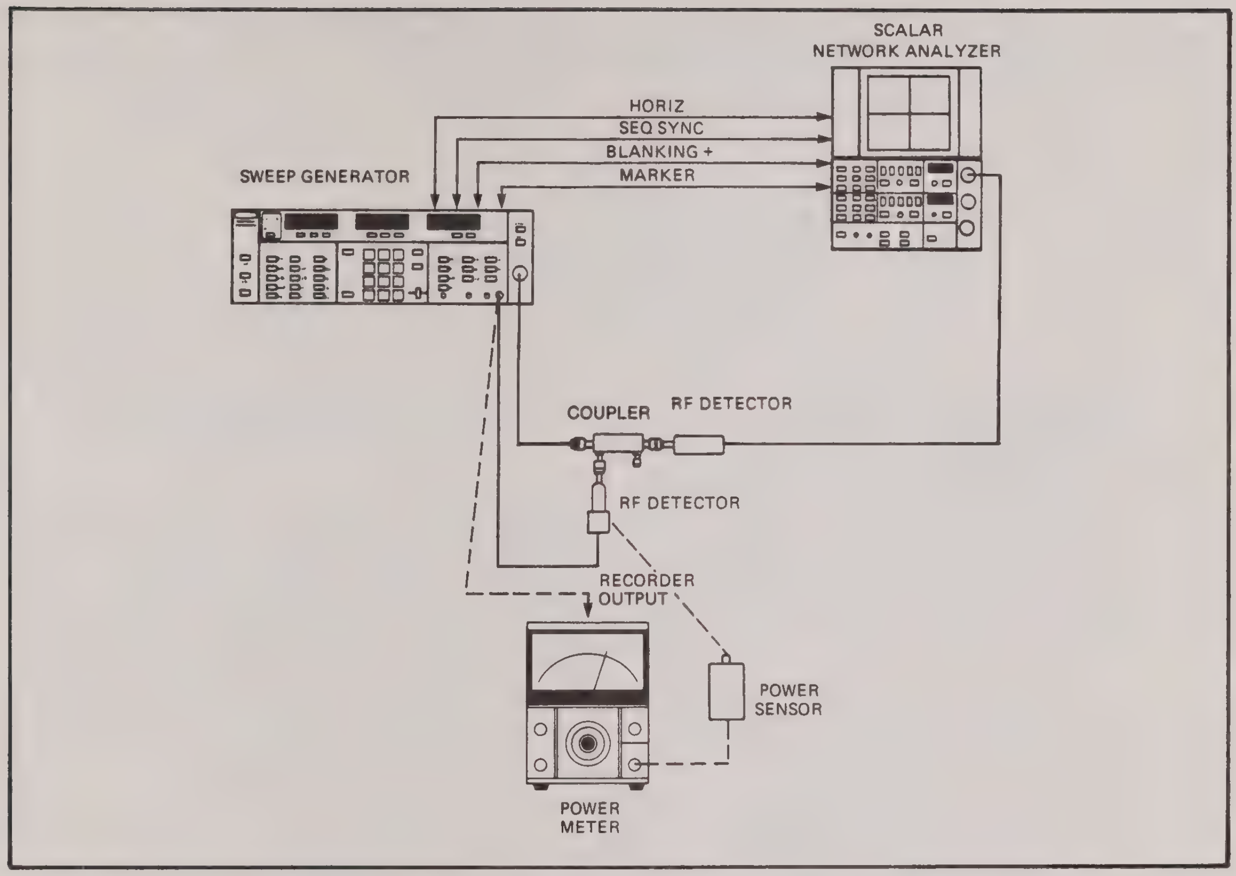

SCALAR NETWORK ANALYZER
HORIZ
SEQ SYNC
BLANKING +
MARKER
SWEEP GENERATOR
COUPLER
RF DETECTOR
RF DETECTOR
RECORDER OUTPUT
POWER SENSOR
POWER METER

Figure 3-26. Test Setup for External Leveling (except 6642A)

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (except 6642A)

1. Connect test equipment for detector leveling, as shown by the solid lines in Figure 3-26.
2. Turn on power on sweep generator (sweeper) and scalar network analyzer (network analyzer).
3. On sweeper,
   a. Press FREQUENCY RANGE – F1-F2.
   b. Set F1 and F2 parameters for a sweep range compatible with the directional coupler being used. For example:
      - Push F1 and set for 1 GHz.
      - Push F2 and set for 12.4 GHz.

      The above two settings are compatible with the NARDA 3202B-10.
   c. Press LEVEL and set for 0 dBm.

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (Continued)

   d. Press SWEEP TIME and set for 50 ms.

   e. Press TRIGGER – AUTO.

   f. Press LEVELING – INTERNAL.

4. On network analyzer,

   a. Position front panel controls as follows:

      CHANNEL A ON: On
         INPUT: A
         MEMORY: Off
         REFERENCE dB/dBm: dBm
         OFFSET: 00.0
         dB PER DIVISION: 1

   b. Press Channel A REF POS LOCATE and adjust SET control to position trace on center graticule line.

   c. Release REF POS LOCATE and observe that a leveled trace slightly below the 0 dBm reference line appears on the CRT.

5. On sweeper,

   a. Press LEVELING – DETECTOR.

   b. Push in on EXTERNAL ALC GAIN control and turn until CAL indicator comes on and stays on.

   c. Release EXTERNAL ALC GAIN.

6. Observe that a leveled trace is present on CRT.

7. Observe that the UNLEVELED indicator on the sweeper is not lit.

8. On sweeper, press LEVELING – DETECTOR to off. Observe that the CRT trace becomes unleveled and the sweeper UNLEVELED indicator lights.

9. Disconnect the RF detector from between the sweeper and the directional coupler; in its place, connect the power meter as shown by the dashed lines in Figure 3-24.

10. On sweeper,

   a. Press CW F1.

   b. Press LEVELING – POWER METER.

   c. Push in on EXTERNAL ALC GAIN control and turn until CAL indicator comes on and stays on.

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (except 6642A) (Continued)

d. Release EXTERNAL ALC GAIN.

NOTE

The response to a changing power level is slow using a power meter; consequently, external leveling should be accomplished using either CW or a slow (99 s) sweep speed.

3-5.4 Operational Checkout Procedure, External Leveling Function (6642A)

External leveling of the RF source is provided by the front panel EXTERNAL INPUT connector and the LEVELING -DETECTOR or -POWER METER pushbutton. In this model, which uses two RF output connectors, external leveling (1) must be used with the 26.5-40 GHz band – which does not contain an internal leveling capability – and (2) can only be used with one band at a time. That is, both the 18-26.5 and 26.5-40 GHz bands cannot be externally leveled at the same time. A test equipment setup for externally leveling the 26.5-40 GHz band is shown in Figure 3-27; the procedure for leveling the 26.5-40 GHz band is given in Table 3-8.

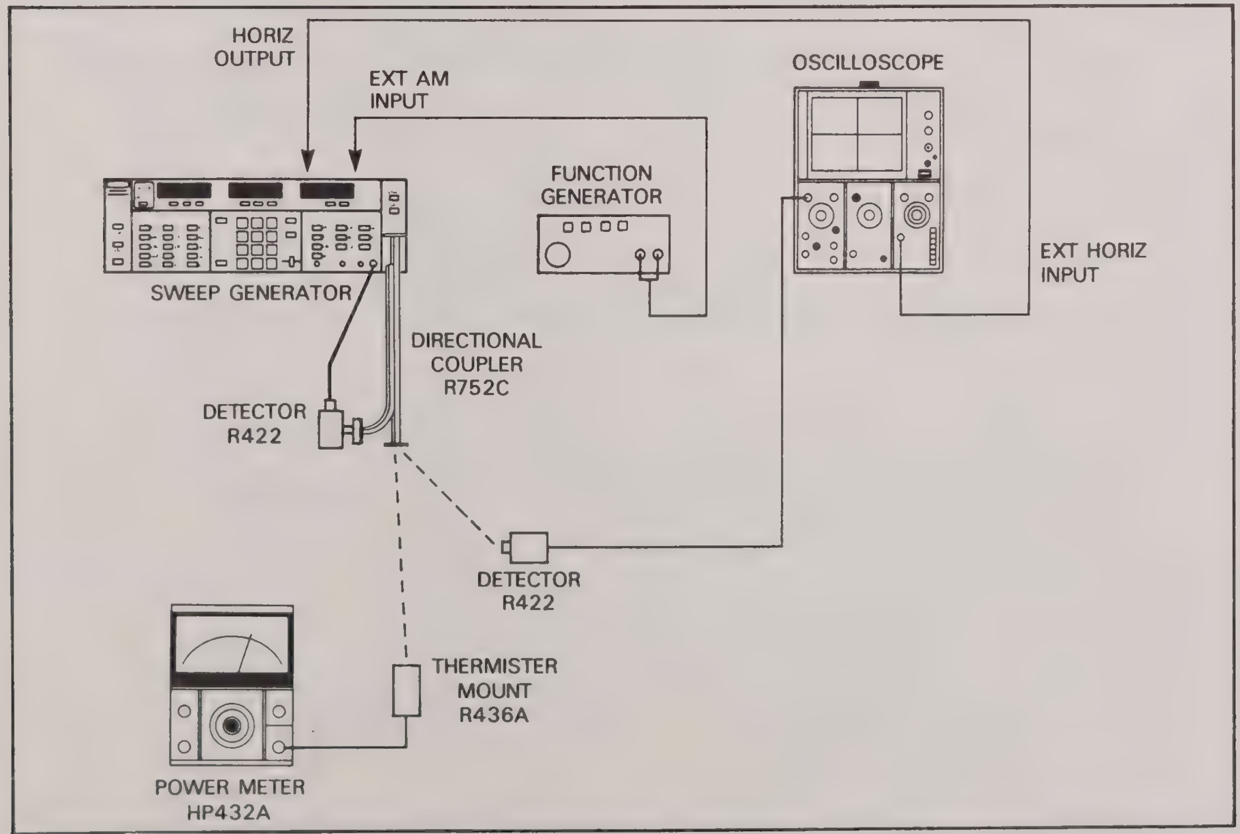

HORIZ OUTPUT
EXT AM INPUT
OSCILLOSCOPE
FUNCTION GENERATOR
SWEEP GENERATOR
EXT HORIZ INPUT
DIRECTIONAL COUPLER R752C
DETECTOR R422
DETECTOR R422
THERMISTER MOUNT R436A
POWER METER HP432A

Figure 3-27. External Leveling Test Setup (6642A)

Table 3-8. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (6642A)

1. Connect test equipment for detector leveling, as shown in Figure 3-27. Turn the equipment on.

2. Adjust function generator for a 10 kHz, 0-300 mV square-wave output.

3. On sweeper,

   a. Adjust RF SLOPE fully counterclockwise to OFF.

   b. Press RESET.

   c. Press CW F1.

   d. Press LEVELING – DETECTOR.

4. On oscilloscope, adjust vertical and horizontal controls to obtain a square wave.

5. On sweeper, adjust EXTERNAL ALC GAIN for best square-wave response.

6. Remove the oscilloscope from the directional coupler, and connect the power meter's thermistor mount in its place.

7. On sweeper,

   a. Adjust EXTERNAL ALC GAIN for a 0 dBm reading on power meter.

   b. Press CW F2.

   c. Readjust EXTERNAL ALC GAIN (if necessary) for 0 dBm power meter reading.

   d. Press CW F1.

   e. Repeat steps a. thru d. as necessary to obtain 0 dBm at both 27 and 40 GHz.

   f. Press LEVEL and set for -10 dBm.

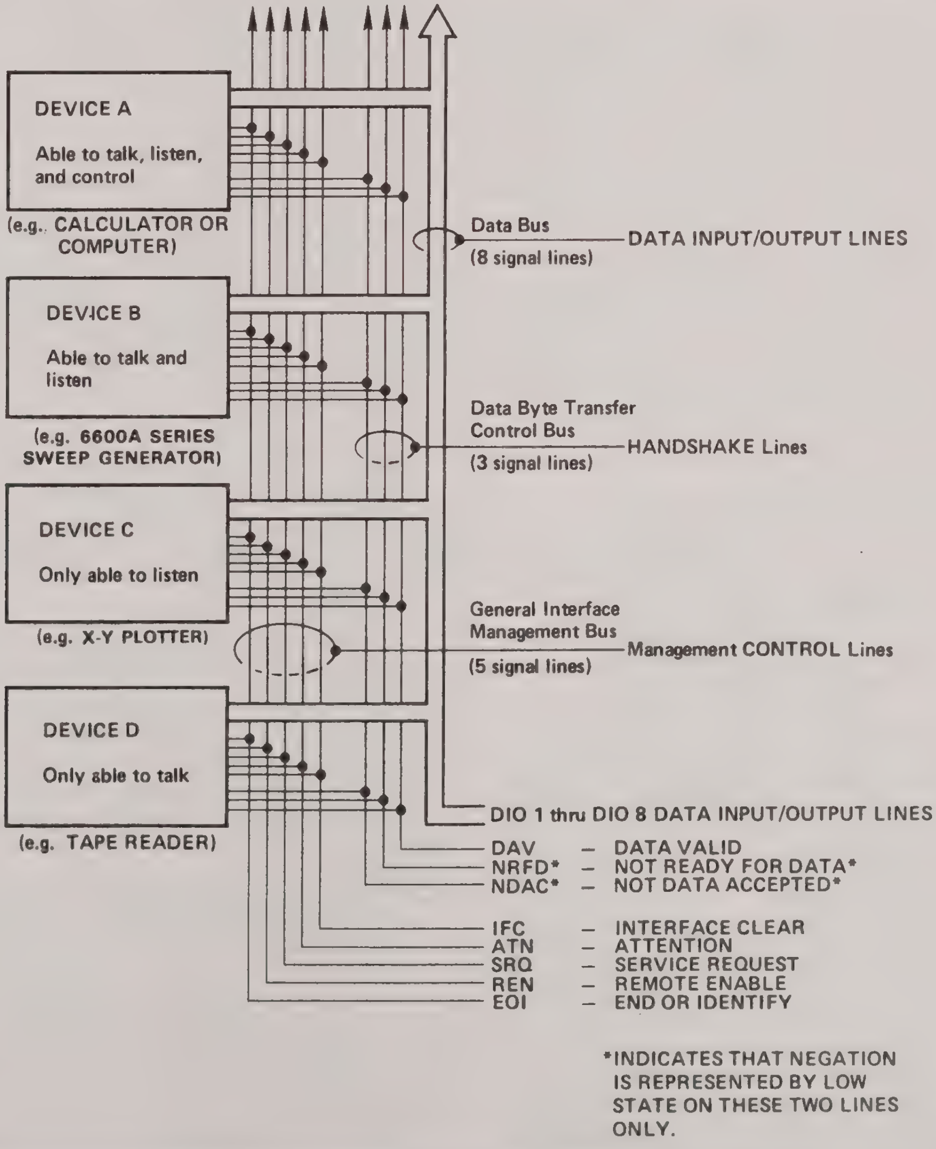
9. Observe that power meter indicates -10 dBm. If not, refer to paragraph 5-11.2 for adjustment instructions.

10. Disconnect the power meter, and connect the waveguide to the device-under-test.

11. The sweeper is now ready for making 0 to -10 dBm leveled power measurements.

3-6 DESCRIPTION OF THE IEEE-488 (IEC-625) INTERFACE BUS

The IEEE-488 bus (General Purpose Interface Bus – GPIB) is an instrumentation interface for integrating instruments, calculators, and computers into systems. The bus uses 16 signal lines to effect transfer of data and commands to as many as 15 instruments. The instruments on the bus are connected in parallel, as shown in Figure 3-28. Eight of the signal lines (DIO 1 thru DIO 8) are used for the transfer of data and other messages in a byte-serial, bit-parallel form. The remaining eight lines are used for communications timing (handshake), control, and status information. Data is transmitted on the eight GPIB data lines as a series of eight-bit characters, referred to as bytes. Normally, a seven-bit ASCII (American Standard Code for


DEVICE A
Able to talk, listen, and control
(e.g., CALCULATOR OR COMPUTER)
DEVICE B
Able to talk and listen
(e.g. 6600A SERIES SWEEP GENERATOR)
DEVICE C
Only able to listen
(e.g. X-Y PLOTTER)
DEVICE D
Only able to talk
(e.g. TAPE READER)
Data Bus
(8 signal lines)
DATA INPUT/OUTPUT LINES
Data Byte Transfer Control Bus
(3 signal lines)
HANDSHAKE Lines
General Interface Management Bus
(5 signal lines)
Management CONTROL Lines
DIO 1 thru DIO 8 DATA INPUT/OUTPUT LINES
DAV – DATA VALID
NRFD* – NOT READY FOR DATA*
NDAC* – NOT DATA ACCEPTED*
IFC – INTERFACE CLEAR
ATN – ATTENTION
SRQ – SERVICE REQUEST
REN – REMOTE ENABLE
EOI – END OR IDENTIFY

*INDICATES THAT NEGATION IS REPRESENTED BY LOW STATE ON THESE TWO LINES ONLY.

Figure 3-28. Interface Connections and Bus Structure

Information Interchange) code is used. The eighth (parity) bit is not used. Data is transferred by means of an interlocked handshake technique. This technique permits asynchronous communications over a wide range of data rates. The following paragraphs provide an overview of the data, management, and handshake buses, and describe how these buses interface with the sweep generator.

3-6.1 Data Bus Description

The data bus contains eight bi-directional, active-low signal lines – DIO 1 thru DIO 8. One byte of information (eight bits) is transferred over the bus at a time. DIO 1 represents the least-significant bit (LSB) in the byte; DIO 8 represents the most-significant bit (MSB) in the byte. Each byte represents a peripheral address (either primary or secondary), a control word, or a data byte. Data bytes are usually formatted in ASCII code, without parity. The data bus provides the conduit for transmitting control information and data between the controller and the instrument (sweep generator).

3-6.2 Management Bus Description

The management bus is a group of five signal lines that are used to control the operation of the bus system. Functional information regarding the individual management-bus control lines is provided below.

a. ATN (attention). When this line is TRUE, the sweep generator will respond to appropriate interface messages (e.g. device clear and serial poll) and to its own listen/talk address.

b. EOI (end or identify). This line is set TRUE during the last byte of a multi-byte message. This line is also used in conjunction with ATN to indicate a parallel-poll.

c. IFC (interface clear). When this line is TRUE, the sweep generator interface functions are placed in a known state, i.e., unaddressed to talk, unaddressed to listen, and service request idle.

d. REN (remote enable). When this line is TRUE, the sweep generator is enabled for entrance into the remote state (i.e., certain front panel functions disabled) upon receipt of its listen address. The remote state is exited when either (1) the REN line is FALSE (high), (2) the go-to-local (GTL) message is received, or (3) the sweep generator programming command RL (return to local) is received.

e. SRQ (service request). This line is pulled LOW (true) by the sweep generator to indicate that certain conditions (paragraph 3-7.4) exist.

3-6.3 Data Byte Transfer Control (Handshake) Bus Description

Information is transferred on the data lines under control of a technique called the three-wire handshake. The three handshake bus signal lines are described below; Figure 3-29 shows a typical interlocking handshake operation.

a. DAV (data valid). This line is set TRUE (arrow 1) when the talker has (1) sensed that NRFD is FALSE, (2) placed a byte of data on the bus, and (3) waited an appropriate length of time for the data to settle.

b. NRFD (not ready for data). This line is set TRUE (arrow 2) by a listener to indicate that valid data has not yet been accepted. The time between the events shown by arrows 1 and 2 is variable, and depends upon the speed with which a listener can accept the information.

c. NDAC (not data accepted). This line is set FALSE by a listener when the listener has accepted the current data byte for internal processing. When the data byte has been accepted, the listener releases its hold on NDAC and allows the line to go FALSE. However, because the GPIB is constructed in a wired-OR configuration, this line will not go FALSE until all listeners participating in the interchange have also released the line. As shown by the arrow labeled 3, when the NDAC line

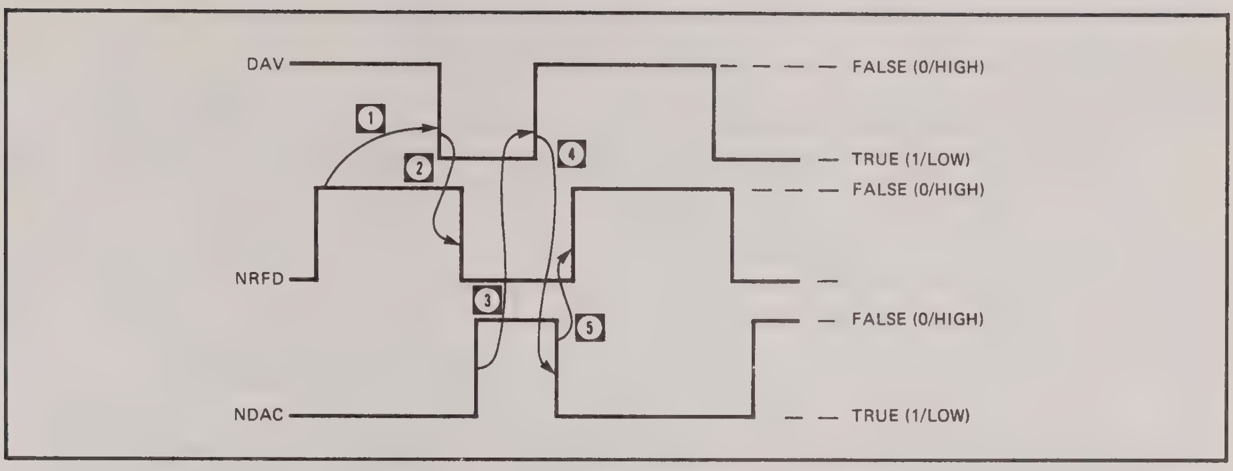


Figure 3-29. Typical Handshake Operation

goes FALSE the DAV line follows suit a short time later. The FALSE state of the DAV line indicates to the bus that valid data has been removed; consequently, with valid data no longer on the line, the NDAC line is pulled LOW again in preparation for the next data interchange. This action is shown by the arrow labeled 4.

The next action that occurs is shown by arrow 5. This arrow shows NRFD going FALSE after NDAC returns to its TRUE state. The FALSE state of NRFD indiciates to the bus that all listeners are ready for the next information interchange. The time period between these last two events (NDAC going TRUE and NRFD going FALSE) is variable and is dependent upon the length of time that it takes a listener to process the data byte. Therefore, the result of the wired-OR construction of the handshake bus is that a talker is forced to wait for the slowest instrument to accept the current data before it can place a new byte of information on the bus.

3-7 GPIB OPERATION (Option 3)

The sweep generator, when equipped with Option 3, has the capability for complete front-panel-control operation over the GPIB. When used on the GPIB, the sweep generator functions as both a listener and a talker; Figure 3-30 provides a listing showing the GPIB subset functions and gives the sweep generator's capability for each function.

To provide bus control, a system of device-dependent commands (hereafter known as bus commands) and IEEE-488 Bus Messages (hereafter known as bus messages) is used. The bus commands (approximately 100 in number) are divided into the following six classes:

1. Front Panel Control Related Commands.
2. Digital Sweep Commands.
3. Group Execute Trigger Mode Commands.
4. Service Request Mode Commands.
5. Output Commands.
6. Miscellaneous Commands.

These six classes of commands are described in paragraphs 3-7.1 thru 3-7.6, respectively. The bus messages recognized by the sweep generator are discussed in paragraph 3-7.7. In addition to bus commands and bus messages, the two types of errors that can occur with bus programming are discussed in paragraph 3-7.8. The sweep generator's default-from-reset-or-turn-on states are described in paragraph 3-7.9. A description of information supplied to provide quick reference data for GPIB programmers is given in paragraph 3-7.10. And an alphabetical index to bus command mnemonics is provided in paragraph 3-7.11.

GPIB SUBSET	FUNCTION	DESCRIPTION
AH1	Acceptor Handshake	Complete Capability
SH1	Source Handshake	Complete Capability
T6	Talker	1. Basic Talker 2. Serial Poll 3. Unaddressed if MLA 4. No Talk Only (TON)
TE0	Talker With Address Extension	No Capability
L4	Listener	1. Basic Listener 2. Unaddressed if MTA 3. No Listen Only (LON)
LE0	Listener With Address Extension	No Capability
SR1	Service Request	Complete Capability
RL1	Remote/Local	Complete Capability
PP1	Parallel Poll	Complete Capability
DC1	Device Clear	Complete Capability
DT1	Device Trigger	Complete Capability
C0	Controller	No Capability

Figure 3-30. 6600A Series Sweep Generator IEEE-488 Interface Bus Subset Capability

3-7.1 GPIB Commands: Front Panel Controls

The GPIB commands used to activate front-panel-control functions are listed in Table 3-9. Programming examples that demonstrate the use of these commands are shown in Figure 3-31.

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands

FRONT PANEL CONTROL	BUS COMMAND	NOTES
A. DATA ENTRY		
1. Parameter Entry Controls		Select the sweep generator parameter and enter the parameter's value. The decimal digits (Xs) in these commands are the parameter's value in either GHz or MHz, seconds or milliseconds, dBm or dB (see below). This value is written in the same manner that it is entered from the keyboard, i.e., either an integer or decimal number (e.g. 2 or 2.21) followed by a suitable terminator (paragraph 3-2.1). The number is not limited to two or four digits; it can be any number of digits, so long as it does not exceed the limits of the instrument.
F0	F0XXXXGH (or MH)	
F1	F1XXXXGH (or MH)	
F2	F2XXXXGH (or MH)	
M1	M1XXXXGH (or MH)	
M2	M2XXXXGH (or MH)	
ΔF	DLFXXXXGH (or MH)	
SWEEP TIME	SWTXXSEC (or MS)	
RF LEVEL	LVLXXDM (or DB)	
2. Data Terminators		Select parameter terminator (paragraph 3-2.1).
GHz	GH	
MHz	MH	
Seconds	SEC	
Milliseconds	MS	
dB	DB	
dBm	DM	
3. SHIFT	SH	Enables shifted functions (paragraph 3-2.1f) to be selected using their unshifted command codes. Example: To select an F1-F2/M1-M2 alternating sweep, program "SH FF MM".
4. CLEAR ENTRY	CLR	Clears invalid (or illegal) parameter entries (paragraph 3-2.1e).
B. FREQUENCY RANGE		
1. Sweep Range Controls		Select sweep range (paragraph 3-2.2a).
FULL	FUL	
F1-F2	FF	
M1-M2	MM	
ΔF F0	DF0	
ΔF F1	DF1	

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands (Continued)

FRONT PANEL CONTROL	BUS COMMAND	NOTES
2. CW Frequency Select Controls		Select sweep range (paragraph 3-2.2b).
CW F0	CF0	
CW F1	CF1	
CW F2	CF2	
CW M1	CM1	
CW M2	CM2	
3. Frequency Vernier Controls		Provide a vernier correction for the selected frequency parameter. Correction is specified in hundreds of kilohertz (paragraph 3-2.2c).
INCREASE	FVSXXXE	
DECREASE	FVS-XXXE	
OFF	FV0	Cancels the vernier correction (paragraph 3-2.2c).
C. TRIGGER Controls		Select trigger mode (paragraph 3-2.3).
AUTO	AUT	Selects AUTO sweep.
LINE	LIN	Selects LINE sweep.
EXT OR	EXT	Selects external sweep.
SINGLE	TRS	Triggers single sweep.
MANUAL SWEEP	MAN	Selects manual frequency tuning. NOTE When MAN command is used, sweep tuning is accomplished using front panel controls.
D. MARKERS Controls		Turn on the selected marker (paragraph 3-2.4).
VIDEO	VM1	
RF	RM1	
INTENSITY	IM1	
All Markers Off	MK0	Turns all markers off.

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands (Continued)

FRONT PANEL CONTROL	BUS COMMAND	NOTES
E. LEVELING Controls		Select the leveling source (paragraph 3-2.5).
INTERNAL	IL1	
DETECTOR	DL1	
POWER METER	PL1	
No Leveling	LV0	Turns leveling off.
F. RF Output Controls		
RF OFF	RF0	Turns RF off.
RF ON	RF1	Turns RF on.
RETRACE RF Off	RT0	Turns RF off during retrace.
RETRACE RF On	RT1	Turns RF on during retrace (paragraph 3-2.6).
G. POWER	None	AC power cannot be turned off and on over the interface bus.
H. SELF TEST	TST	Initiates a self-test (paragraph 3-4).
I. RESET	RST	Resets all parameters and controls to a predetermined (initialized) state (paragraph 3-2.7). NOTE The RST command causes the sweep generator's GPIB interface to become unaddressed. Therefore, RST should be used alone.
J. FM OR PHASELOCK		Allows external frequency modulation or phase-lock control to be applied to the sweep generator (paragraph 3-2.2d).
Off	FM0	
On	FM1	

EXAMPLE 1

(Assumes sweep generator
set to address 5)

Sweep Range: F1-F2
F1 Frequency: 5.3 GHz
F2 Frequency: 12.6 GHz

TRIGGER: LINE
RF: On
LEVELING: INTERNAL

```
10 OUTPUT 705 ;"FF F15 3GH F212
.6GH LIN RF1 IL1"
```

EXAMPLE 2

(Assumes sweep generator
set to address 5)

Sweep Range: ΔF F0
F0 Frequency: 2 GHz
ΔF Frequency: 10 MHz
TRIGGER: AUTO

FM OR PHASELOCK: On
Set Vernier: -7.5 MHz
LEVELING: INTERNAL
RF: On

```
10 OUTPUT 705 ;"DF0 F02GH DLF10M
H AUT FM1 FVS-75E IL1 RF1"
```

Figure 3-31. GPIB Front Panel Programming Examples

3-7.2 GPIB Commands: Step Sweep

To provide a high-resolution sweep over a narrow band of frequencies, the sweep generator is equipped with a digitally stepped sweep (step sweep). This sweep, which contains 4096 discrete points, can be incrementally stepped so that any number (or all) of the discrete points can be used. The width of the step sweep and the frequency start and stop points (or center frequency for a ΔF sweep) are selected using front-panel-control command statements. (Example: FF F1XXXXGH F2XXXXGH, DF0 F0XXXXGH, DLFXXXXMH, or MM M1XXXXMH M2XXXXMH.) Because the step sweep is a frequency sweep, the following apply:

a. The front panel LED displays remain unchanged as the sweep progresses from start to stop.

b. The frequencies corresponding to the step sweep's intermediate steps must be calculated. The formula for calculating step sweep frequencies is given in Appendix 2.

The step sweep commands are given in Table 3-10.

Table 3-10. 6600A Series Sweep Generator Digital Sweep Commands

NAME	COMMAND	FUNCTION
Step Sweep	STP	Selects the Step Sweep mode of operation.
Step Select	STSXXXXE	Selects the increment point at which the Step Sweep starts. This sweep start can be any point from 0 to 4095. Zero is the usual starting point, in which case STS0E (or STSE) is the command to use.

Table 3-10. 6600A Series Sweep Generator Digital Sweep Commands (Continued)

NAME	COMMAND	FUNCTION
Increment Size	SIZXXXXE	Selects the number of steps by which the Step Sweep is to be incremented when an "N" command (see below) is received. Also, selects the number of steps in which an "UP" or "DN" command (Table 3-14) will increment the selected parameter (paragraph 3-2.1a). The Xs in this command represent digits. A maximum of 4 and a minimum of 0 digits may be used. The number that is formed by the digits must be an integer. If a fractional number is used, any digits that appear to the right of the decimal point are ignored. (Example: SIZ146E and SIZ146.5E are equivalent commands.)
Go to Next Step	N	Increments the Step Sweep by the number of steps programmed with the Increment Size Command. The following is an example of the syntax required to implement a step sweep that starts at 0 volts, has an increment size of 819 steps, and takes data at 5 discrete frequency points:

```
10 OUTPUT 705;*  "STP STSE SIZ819E"
20 FOR I = 0 TO 4
30 •
40 •  Input Statements, etc.
50 •
60 OUTPUT 705; "N"
70 NEXT I
```

---

*Assumes sweep generator address is 5.

3-7.3 GPIB Commands: Group Execute Trigger Modes

To speed up bus operations, the Group Execute Trigger (GET) bus message can be used to increment or decrement frequency, sweep time, or output-power level. The GET bus message can also be used to increment or decrement the step sweep. The bus commands that configure the sweep generator for this increase/decrease response to a GET bus message are listed in Table 3-11.

Table 3-11. 6600A Series Sweep Generator Group Execute Trigger (GET) Mode Commands

NAME	COMMAND	FUNCTION
Trigger Single Sweep	GTS	Configures the sweep generator to execute a single sweep each time a GET bus message is received. This is the default mode, i.e., the mode assumed when no GET Mode command is programmed.
Increment-Selected Parameter	GTU	Configures the sweep generator to execute an "UP" command (Table 3-14) each time a GET bus message is received.
Decrement-Selected Parameter	GTD	Configures the sweep generator to execute a "DN" command (Table 3-14) each time a GET bus message is received.
Go to Next Step	GTN	Configures the sweep generator to execute an "N" command (Table 3-10) each time a GET bus message is received.

3-7.4 GPIB Commands: Service Request Modes

To notify the controller that certain conditions exist (such as end-of-sweep, marker encountered, unleveled, and error entry), the sweep generator uses the GPIB Service Request function. To use this function, the sweep generator employs a system of Service Request mode commands; these commands are described in Table 3-12.

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands

NAME	COMMAND	FUNCTION
Enable SRQ Capability	SQ1	Enables the following SRQ mode commands to request service from the controller.
Disable SRQ Capability	SQ0	Disables the SRQ function. This is the default mode, i.e., the mode assumed when neither SQ1 nor SQ0 is programmed.
Dwell-at-Marker Mode:		
On	DW1	Activates the dwell-at-marker mode. In this mode, when an intensity marker is encountered, the frequency sweep will dwell at the marker until a Continue Sweep (CNT) command is received. When DW1 and SQ1 are

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands (Continued)

NAME	COMMAND	FUNCTION
Dwell-at-Marker Mode (continued):		both programmed, the SRQ line is pulled LOW (true), and Status Byte (Figure 3-32) bits 0 and 6 are set HIGH (decimal 65). When DW1 and SQ0 are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	DW0	Deactivates the dwell-at-marker mode. This is the default mode, i.e., the mode assumed when neither DW1 nor DW0 is programmed.
End-of-Sweep Mode:		
On	ES1	Activates the end-of-sweep mode. When ES1 and SQ1 are both programmed, the ending of the frequency sweep causes the SRQ line to be pulled LOW (true) and Status Byte bits 1 and 6 to be set HIGH (decimal 66). When ES1 and SQ0 are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	ES0	Deactivates end-of-sweep mode. This is the default mode, i.e., the mode assumed when neither ES1 nor ES0 is programmed.
Unleveled Condition Mode:		
On	UL1	Activates the unleveled-condition mode. When UL1 and SQ1 are both programmed, an unleveled output-power condition causes the SRQ line to be pulled LOW (true) and Status Byte bits 2 and 6 to be set HIGH (decimal 68). When UL1 and SQ0 are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	UL0	Deactivates the unleveled condition mode. This is the default mode; i.e., the mode assumed when neither UL0 nor UL1 is programmed.
Parameter-Entry Error Mode:		
On	PE1	Activates the parameter-entry error mode. When PE1 and SQ1 are both programmed, a parameter-entry error (paragraph 3-7.8) causes the SRQ line to be pulled LOW (true) and Status Byte bits 4 and 6 to be set HIGH (decimal 80). When PE1 and SQ0 are both programmed, only the Status Byte is generated; the SRQ line is not activated.

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands (Continued)

NAME	COMMAND	FUNCTION
Parameter-Entry Error Mode (continued):		
Off	PE0	Deactivates the parameter-entry error mode. This is the default mode; i.e., the mode assumed when neither PE0 nor PE1 is programmed.
Syntax Error Mode:		
On	SE1	Activates the syntax error mode. When SE1 and SQ1 are both programmed, a syntax error (paragraph 3-7.8) causes the SRQ line to be pulled LOW (true) and Status Byte bits 5 and 6 to be set HIGH (decimal 96). When SE1 and SQ0 are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	SE0	Deactivates the syntax error mode. This is the default mode, i.e., the mode assumed when neither SE0 nor SE1 is programmed.

STATUS BYTE BITS

7	6	5	4	3	2	1	0

Bits 3 and 7 are not used by the sweep generator.

Bit 6 is the request service bit. This bit is set HIGH when certain conditions, as shown below, exist.

Bits 0, 1, 2, 4, and 5 are combined with the service request bit to provide a code number that tells the controller which condition exists. The condition codes are given below.

Bit 6 & 0 set HIGH: An intensity marker was encountered.

Bit 6 & 1 set HIGH: The frequency sweep has ended.

Bit 6 & 2 set HIGH: An unleveled RF output condition has been detected.

Bit 6 & 4 set HIGH: An invalid parameter was entered.

Bit 6 & 5 set HIGH: A syntax error has been detected.

NOTE

The Status Byte is explained under "Serial Poll Operation" in Table 3-15.

Figure 3-32. Sweep Generator Status-Byte Coding

3-7.5 GPIB Commands: Output

To provide equipment identification and parameter information upon request, the sweep generator is equipped with output commands. The use of these commands causes the sweep generator to output the requested information when next addressed to talk. These output commands are given in Table 3-13.

Table 3-13. 6600A Series Sweep Generator Output Commands

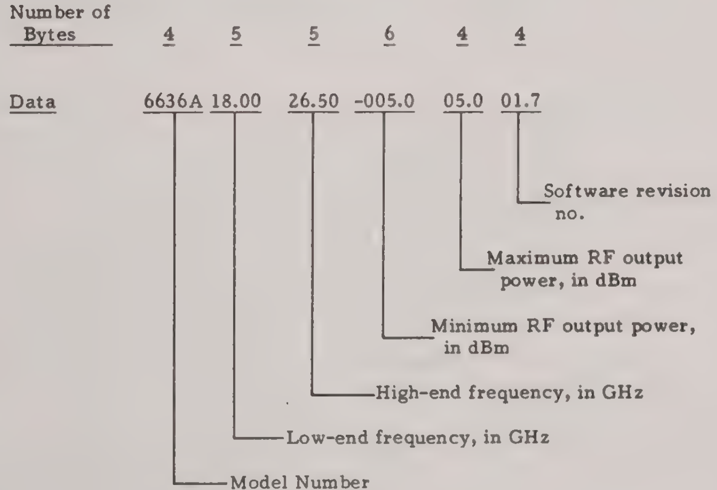
NAME	COMMAND	FUNCTION
Output Identify	OI	Causes the sweep generator to identify itself by sending certain parameter information over the bus. This parameter information consists of model number, low-end frequency, high-end frequency, minimum output-power level, maximum output-power level, and software revision number. This command can be used to send parameter information to the controller automatically, thus relieving the operator from having to input the information manually. The format in which the OI data is returned is shown below.  Number of Bytes 4 5 5 6 4 4 Data 6636A 18.00 26.50 -005.0 05.0 01.7 Software revision no. Maximum RF output power, in dBm Minimum RF output power, in dBm High-end frequency, in GHz Low-end frequency, in GHz Model Number
Output ΔF Parameter	ODF	Returns the value of the ΔF frequency parameter to the controller, value is given in MHz.
Output F0 Parameter	OF0	Returns the value of the F0 frequency parameter to the controller. Value is given in MHz.
Output F1 Parameter	OF1	Returns the F1 frequency value, as described above.
Output F2 Parameter	OF2	Returns the F2 frequency value, as described above.

Table 3-13. 6600A Series Sweep Generator Output Commands (Continued)

NAME	COMMAND	FUNCTION
Output F_{low}	OFL	Returns the low-end frequency value, as described above.
Output F_{high}	OFH	Returns the high-end frequency value, as described above.
Output M1 Parameter	OM1	Returns the M1 frequency value, as described above.
Output M2 Parameter	OM2	Returns the M2 frequency value, as described above.
Output Power Level	OLV	Returns the output-power level value to the controller. Value is given in ±0.1 dB increments.
Output Status Byte	OSB	Returns the Status Byte (Figure 3-32) to the controller.
Output Sweep Time	OST	Returns the sweep time value to the controller. Value is given in milliseconds.

3-7.6 GPIB Commands: Miscellaneous

There are 9 GPIB commands unrelated to either front-panel, digital-sweep, GET-mode, SRQ-mode or output operation. These miscellaneous commands are described in Table 3-14.

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands

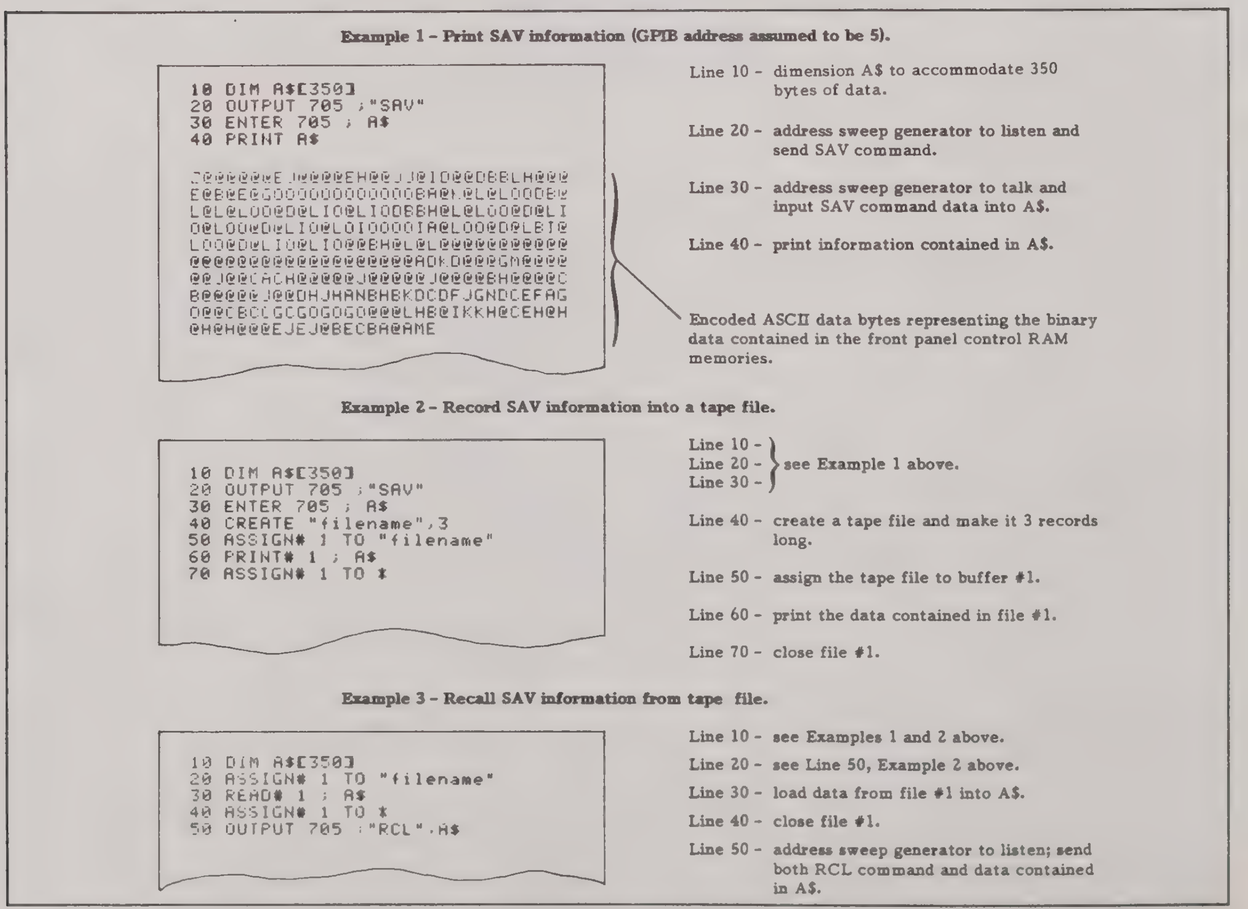
NAME	COMMAND	FUNCTION
Continue Sweep	CNT	Causes the sweep to continue after having dwelled at an intensity marker. CNT is used in conjunction with the SRQ Dwell-at-Marker Mode.
Front Panel Displays:		
Off	DS0	Turns off the front panel numeric displays so that unauthorized personnel cannot read the frequency range currently in use.
On	DS1	Turns the front panel numeric displays on. This is the default, or unprogrammed, condition (paragraph 3-7.9).

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands (Continued)

NAME	COMMAND	FUNCTION
Decrement the Selected Parameter	DN	Decrements the selected frequency, sweep time, or RF level parameter by the number of steps programmed with the Increment Size command (SIZ). For DN to be effective, the selected parameter must still be active. That is, the selected parameter's command statement (F1XXXXGH, SWTXXMS, LVLXXDM, etc.) must be the last command to appear before DN is commanded. A non-parameter command, such as AUT, IL1, or VM1, cannot be sandwiched between the parameter mnemonic and the DN command. If necessary, ensure that the selected parameter is still active by prefacing DN (or a string of DNs) with the selected parameter's mnemonic. For example, send F1 DN (or DN DN DN etc.) rather than just DN (or DN DN DN etc.).
Increment the Selected Parameter	UP	Increments the selected frequency, sweep time, or RF level parameter by the number of steps programmed with the Increment Size command (SIZ). As described for the DN command, above, the selected parameter must still be active for UP to be effective.
CW Filter:		
Out	FL0	Causes the CW filter to be out of the RF output signal line.
In	FL1	Inserts a CW filter in the RF output signal line. This command overrides the CW filter control inherent in front-panel programming (i.e., CW filter inserted for sweep widths 50 MHz and below and not inserted for sweep widths above 50 MHz).
Return to Local	RL	Causes the sweep generator to return to local (front panel) control, provided that a local lockout message (Table 3-15) is not in effect.
Recall the Front Panel Control Settings	RCL	Causes the sweep generator to be reconfigured with the front-panel-control settings that were previously saved using the SAV command (below). Figure 3-33 provides a programming example.
Horizontal Output During CW		
OFF ON	CS0 CS1	Operation is the same as that described for the CW RAMP function in paragraph 3-2.1f.3.

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands (Continued)

NAME	COMMAND	FUNCTION
Reset Sweep	RSS	Resets the frequency sweep to the sweep-start frequency, as programmed by a Parameter Entry command (e.g. FFF1XXXXGH). RSS can be used to abort the sweep currently in progress prior to sending a trigger command.
Save the Front Panel Control Settings	SAV	Causes the sweep generator to return an ASCII encoded representation of the entire instrument setup. This instrument setup information is contained in a data string approximately 310 bytes long. The SAV command can be used to store the front-panel-control settings for a measurement test setup. This test setup information can be stored on a program tape for future use. Figure 3-33 provides a programming example.



Example 1 - Print SAV information (GPIB address assumed to be 5).

```
10 DIM A$[350]
20 OUTPUT 705 ;"SAV"
30 ENTER 705 ; A$
40 PRINT A$

J@@@@@@E J@@@@EH@@J J@IO@@DBBLH@@@
E@B@E@GOOOOOOOOOOOOOBA@K@L@LOODB@
L@L@LOO@D@LIO@LIODBBH@L@LOO@D@LI
O@LOO@D@LIO@LOIOOOOIA@LOO@D@LBI@
LOO@D@LIO@LIO@@BH@L@L@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@ADKD@@@GM@@@@
@@J@@CACH@@@@J@@@@@J@@@@BH@@@@C
B@@@@@J@@DHJHANBHBKDCDFJGNDCEFAG
O@@CBCLGCGOGOGO@@@LHB@IKKH@CEH@H
@H@H@@@EJEJ@BECBA@AME
```

Line 10 - dimension A$ to accommodate 350 bytes of data.

Line 20 - address sweep generator to listen and send SAV command.

Line 30 - address sweep generator to talk and input SAV command data into A$.

Line 40 - print information contained in A$.

Encoded ASCII data bytes representing the binary data contained in the front panel control RAM memories.

Example 2 - Record SAV information into a tape file.

```
10 DIM A$[350]
20 OUTPUT 705 ;"SAV"
30 ENTER 705 ; A$
40 CREATE "filename",3
50 ASSIGN# 1 TO "filename"
60 PRINT# 1 ; A$
70 ASSIGN# 1 TO *
```

Line 10 -
Line 20 - see Example 1 above.
Line 30 -

Line 40 - create a tape file and make it 3 records long.

Line 50 - assign the tape file to buffer #1.

Line 60 - print the data contained in file #1.

Line 70 - close file #1.

Example 3 - Recall SAV information from tape file.

```
10 DIM A$[350]
20 ASSIGN# 1 TO "filename"
30 READ# 1 ; A$
40 ASSIGN# 1 TO *
50 OUTPUT 705 ;"RCL",A$
```

Line 10 - see Examples 1 and 2 above.

Line 20 - see Line 50, Example 2 above.

Line 30 - load data from file #1 into A$.

Line 40 - close file #1.

Line 50 - address sweep generator to listen; send both RCL command and data contained in A$.

Figure 3-33. Programming Examples Using SAV and RCL Commands

3-7.7 Bus Messages

The 6600 Series Sweep Generators recognize most of the IEEE-488 bus messages. A listing of the recognized bus messages, including specific information describing how the messages are used, is given in Table 3-15. Sample program statements showing how the WILTRON 85/HP9845A, HP 9825A, and Tektronix 4051/4052 bus controllers implement the recognized bus messages are shown in Table 3-16.

Table 3-15. Bus Messages Recognized by the 6600A Series Sweep Generators

BUS MESSAGE	HOW MESSAGE IS USED BY SWEEP GENERATOR
Device Clear	1. Aborts all current sweep generator GPIB activities. 2. Resets the STS, SIZ, SQ1, DW1, UL1, ES1, EF, and EI commands to their default condition (paragraph 3-7.9).
Go to Local	Returns the sweep generator to local control.
Group Execute Trigger	1. Triggers a new sweep if the EXT (Table 3-9) and the GTS (Table 3-11) commands are both programmed. 2. Increments the selected parameter (paragraph 3-2.1a) by the number of steps programmed using the SIZ command (Table 3-10) if the GTU command (Table 3-11) is programmed. 3. Decrements the selected parameter by the number of steps programmed using the SIZ command if the GTD command (Table 3-11) is programmed. 4. Increments the digital sweep by the number of steps programmed using the SIZ command if the GTN command (Table 3-11) is programmed.
Interface Clear	Stops the sweep generator GPIB interface from listening or talking. The front panel controls are not cleared.
Local Lockout	Prevents the RETURN TO LOCAL pushbutton or the RL command (Table 3-14) from returning the sweep generator to local control.
Remote Enable	Places the sweep generator under remote control if the REM line is TRUE and the sweep generator is addressed to listen. If placed in remote and not supplied with program data, sweep generator operation is determined by the position in which the front panel controls were set immediately prior to going remote.
Service Request (SRQ) Messages:	The sweep generator is equipped with SRQ capability. It will respond to both serial- and parallel-poll messages. Serial- and parallel-poll operations are described below.

Table 3-15. Bus Messages Recognized by the 6600A Series Sweep Generators (Continued)

BUS MESSAGE	HOW MESSAGE IS USED BY SWEEP GENERATOR
Serial-Poll Enable (SPE) Serial-Poll Disable (SPD)	Serial Poll Operation The SPE message causes the sweep generator to respond with a decimally-coded status byte (Figure 3-32). This status byte is coded to give the controller two pieces of information: 1. Whether it was the device requesting service. 2. If it was the service-requesting device, the type of service that it needs. The SPD message, which is sent by the controller in response to receiving a status byte, terminates serial-poll operation.
Parallel-Poll Configure (PPC) Parallel-Poll Enable (PPE) Parallel-Poll Unconfigure (PPU) Parallel-Poll Disable (PPD)	Parallel-Poll Operation When queried by a parallel-poll message command (PPOLL or pol; see Table 3-16), the sweep generator (if configured for parallel-poll operation; see below) responds by setting its assigned data bus line to the logical state (1, 0) that indicates its correct SRQ status. To configure a bus device that is (1) built for parallel-poll operation and (2) designed to be remotely configured on the bus, the controller sends a two-byte parallel-poll configure and enable (PPC and PPE) message. The PPC byte configures the device to respond to a parallel-poll message such as PPOLL or pol. The PPE byte assigns the logical sense (1, 0) that the parallel-poll response will take. When the sweep generator receives the PPC/PPE message, it configures itself to properly respond to the parallel-poll message. The PPU (or PPD) message is sent by the controller when a parallel-poll response is no longer desired. This message causes the sweep generator to become unconfigured for parallel-poll response.

Table 3-16. Sample Bus Message Statements

BUS MESSAGE	SAMPLE STATEMENT SHOWING HOW MESSAGE IS IMPLEMENTED		
	MODELS 85/9845A	HP 9825	TEKTRONIX 4051
Go to Local (GTL)	LOCAL 7[1] LOCAL 705[2]	lcl 7[1] lcl 705[2]	WBYTE Ω 95,[2] 63, 37, 4:
Group Execute Trigger (GET)	TRIGGER 7 TRIGGER 705	trg 7 trg 705	WBYTE Ω 95,[2] 63, 37, 8:
Interface Clear (IFC)	ABORTIO 7 ABORTIO 705	cli 7 cli 705	
Local Lockout (LLO)	LOCAL LOCKOUT 7	llo 7	WBYTE Ω 17:[1]
Remote Enable	REMOTE 7 REMOTE 705	rem 7 rem 705	PRINT Ω 5[2]
Serial Poll (Query Message)	SPOLL (7) SPOLL (705)	rds (7)→A: if bit (7, A); gto (Line No.)	POLL A, B; 5[2]
Parallel Poll (Query Message)	PPOLL (7)	pol (7)→A: if bit (0, A) = 1; gsb "Serv 0": if bit (1, A) = 1; gsb "Serv 1"	
Parallel Poll Configure (PPC) (The statements assign the sweep generator data line DIO5 for parallel-poll response with Sense (S) = 0.)	MODEL 85 ONLY: SEND 7; LISTEN 5 CMD 3 SCG 5 UNL HP 9845 ONLY: PPOLL CONFIGURE 705; 5	polc 705, 5[2]	

[1] Sends message to all bus instruments.

[2] Sends message to instrument at address 5 (sweep generator).

Table 3-16. Sample Bus Message Statements (Continued)

BUS MESSAGE	SAMPLE STATEMENT SHOWING HOW MESSAGE IS IMPLEMENTED		
	MODELS 85/9845A	HP 9825	TEKTRONIX 4051
Parallel Poll Unconfigure (PPU)	MODEL 85 ONLY: SEND 7; LISTEN 5 CMD 21 HP 9845 ONLY: PPOLL UNCONFIGURE 705	polu 7 polu 705	
Device Clear (DC and SDC)	MODEL 85 ONLY: CLEAR 7 CLEAR 705 HP 9845 ONLY: RESET 7 RESET 705	clr 7 clr 705	INIT[1] WBYTE Ω 95, 63, 37, 4:[2]

[1] Sends message to all bus instruments.
[2] Sends message to instrument at address 5 (sweep generator).

3-7.8 Program Errors

There are two types of errors that occur in bus programming: invalid-parameter errors and syntax errors. These two error types are described below.

a. Invalid-Parameter Error. Invalid-parameter errors are those that will cause either the front panel CLEAR ENTRY, F1>F2 OR M1>M2 CHANGE FREQ SETTING, or GHz/dBm/Sec and MHz/dB/mS indicators to flash. These errors include:

   1. Programming a frequency sweep where F1 is greater than F2 or M1 is greater than M2 (backward sweep, paragraph 3-2.1e).

   2. Attempting to enter a frequency, sweep-time, or RF level parameter that exceeds the limits of the sweep generator.

   3. Failing to properly end a parameter entry with a suitable terminator, such as MH, DB, MS, etc.

   Invalid-parameter errors cause the front-panel indicators to flash.

b. Syntax Errors. Syntax errors are errors that occur in the formulation of a program statement, such as writing "EXTTFS" instead of "EXTTRS". To prevent misinterpretation of command statements, the sweep generator ignores all portions of the command statement following the syntax error. All commands are ignored until the sweep generator receives the Unlisten command (ASCII ?) over the bus or until the sweep generator is addressed to talk. An example showing how the sweep generator evaluates a syntax error is given in Figure 3-34.

Correctly-written program statement commanding external sweep, trigger sweep, and RF marker (sweep generator assumed to be set to address 5):

```
10 OUTPUT 705; "EXTTRSRM1"
```

Same program statement with syntax error.

```
10 OUTPUT 705; "EXTTFSRM1"
```

error

This portion of the program statement, plus all future statements, is ignored until sweep generator receives the Unlisten (UNL) command (ASCII ?). The Unlisten Command is normally sent over the bus either (1) immediately prior to the next time the sweep generator is addressed (HP 9825 or Model 85, see below) or (2) immediately after the last data byte of the current data transaction has been received (TEK 4051 and PET 2001).

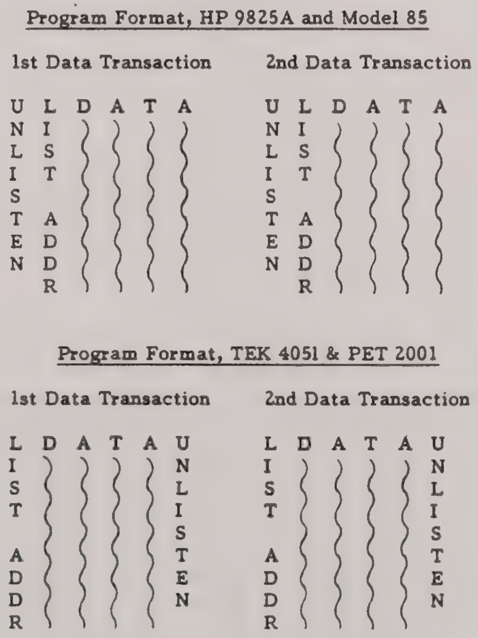

Program Format, HP 9825A and Model 85
1st Data Transaction
2nd Data Transaction
UNLISTEN
LIST ADDR
DATA
UNLISTEN
LIST ADDR
DATA
Program Format, TEK 4051 & PET 2001
1st Data Transaction
2nd Data Transaction
LIST ADDR
DATA
UNLISTEN
LIST ADDR
DATA
UNLISTEN

Figure 3-34. Program Statement with Syntax Error (Example)

3-7.9 Reset Programming and Default Conditions

Reset programming provides the means for quickly returning the sweep generator to its default (preprogrammed) operational state. In the manual (local) mode, the default state can be entered into only by pressing the RESET pushbutton. In the GPIB (remote) mode, however, there are several ways in which to enter the default state. These reset-programming methods, along with related data, are given in Table 3-17. The default settings for the numeric frequency, sweep time, and output power level parameters are the same as those given for the RESET pushbutton (Table 3-1). A recommended command sequence for reset programming is given in Figure 3-35. The use of this recommended command sequence assures that all parameters and commands assume their preprogrammed state each time reset is desired.

Line #	Purpose
10	Sends Device Clear Bus Message. This message clears the sweep generator GPIB interface.
20	Sends Reset Bus Command. This command resets the sweep generator front panel controls to a predetermined (initialized) state.
30	Sends new front panel settings: full sweep, internal leveling, and output-power level of 0 dBm.

```
10 CLEAR 705
20 OUTPUT 705 ;"RST"
30 OUTPUT 705 ;"FUL IL1 LVL0DM"
```

Figure 3-35. Reset Programming Statements

Table 3-17. Resetting the Sweep Generator GPIB Interface Circuits

METHODS OF RESETTING GPIB INTERFACE CIRCUITS	FUNCTIONS AFFECTED	DEFAULT CONDITION
1. Pressing RETURN TO LOCAL pushbutton.	Digital Sweep	STS = 0 SIZ = 0
	Service Request Modes	SQ0 DW0 UL0 ES0
	Group Execute Trigger Mode	GTS
	Bus Messages	Local

Table 3-17. Resetting the Sweep Generator GPIB Interface Circuits (Continued)

METHODS OF RESETTING GPIB INTERFACE CIRCUITS	FUNCTIONS AFFECTED	DEFAULT CONDITION
2. Pressing RESET pushbutton.	Same as above.	Same as above, plus local and local lockout messages are also reset.
3. Sending RST command over the bus.	Same as above.	Same as 2, above.
4. Executing the interface message Device Clear.	Same as above.	Same as 1, above, except local bus message is not reset.
5. Turning the POWER switch on and off.	Same as above	Same as 2, above.

3-7.10 Quick Reference Data

An alphabetical index of sweep generator GPIB command codes, along with a tabulation of default data, is provided in Appendix 1. This appendix may be copied and used as a handy source for the quick reference of certain GPIB programming data.

3-7.11 Index of Sweep Generator GPIB Command Codes

An alphabetical index of the sweep generator GPIB command codes is given in Table 3-18. This table lists the command mnemonic, the name of the command, and the table number where the command is described.

Table 3-18. Index of Sweep Generator GPIB Command Mnemonics

MNEMONIC	NAME	TABLE NO.
AUT	Auto Trigger	3-9
CF0	CW Select F0	3-9
CF1	CW Select F1	3-9
CF2	CW Select F2	3-9
CLR	Clear Keypad	3-9
CM1	CW Select M1	3-9
CM2	CW Select M2	3-9
CNT	Continue Sweep	3-14
CS0	Horizontal Output Off During CW Operation	3-14
CS1	Horizontal Output On During CW Operation	3-14
DB	dB Data Terminator	3-9
DF0	Sweep Range ΔF F0	3-9
DF1	Sweep Range ΔF F1	3-9
DL1	Detector Leveling	3-9
DLF	Enter ΔF Frequency	3-9
DM	dBm Data Terminator	3-9
DN	Decrement Selected Parameter	3-14
DS0	Front Panel Displays Off	3-14
DS1	Front Panel Displays On	3-14
DW0	Dwell at Marker Mode Off	3-12
DW1	Dwell at Marker Mode On	3-12
ES0	End of Sweep Mode Off	3-12

Table 3-18. Index of Sweep Generator GPIB Command Mnemonics (Continued)

MNEMONIC	NAME	TABLE NO.
ES1	End of Sweep Mode On	3-12
EXT	External Trigger	3-9
F0	Enter Parameter F0	3-9
F1	Enter Parameter F1	3-9
F2	Enter Parameter F2	3-9
FF	Sweep Range F1-F2	3-9
FL0	CW Filter Off	3-14
FL1	CW Filter On	3-14
FM0	Frequency Modulation Off	3-9
FM1	Frequency Modulation On	3-9
FUL	Sweep Range Full	3-9
FV0	Frequency Vernier Off	3-9
FVS	Set Frequency Vernier	3-9
GH	GHz Data Terminator	3-9
GTD	GET* Mode Execute "DN" Command	3-11
GTN	GET Mode Execute "N" Command	3-11
GTS	GET Mode Trigger Sweep	3-11
GTU	GET Mode Execute "UP" Command	3-11
IL1	Internal Leveling	3-9
IM1	Intensity Marker	3-9
LIN	Line Trigger	3-9
LV0	Leveling Off	3-9
LVL	Enter Level Parameter	3-9
M1	Enter M1 Parameter	3-9
M2	Enter M2 Parameter	3-9
MAN	Manual Sweep	3-9
MH	MHz Data Terminator	3-9
MK0	Markers Off	3-9
MM	Sweep Range M1-M2	3-9
MS	Millisecond Data Terminator	3-9
N	Go to Next Increment (Digital Sweep)	3-10
ODF	Output ΔF Frequency	3-13
OI	Identify Instrument	3-13
OF0	Output F0 Frequency	3-13
OF1	Output F1 Frequency	3-13
OF2	Output F2 Frequency	3-13
OFL	Output Low-End Frequency	3-13
OFH	Output High-End Frequency	3-13
OLV	Output RF Level	3-13
OM1	Output M1 Frequency	3-13
OM2	Output M2 Frequency	3-13
OSB	Output Status Byte	3-13
OST	Output Sweep Time	3-13
PE0	Parameter Entry Error Mode Off	3-12
PE1	Parameter Entry Error Mode On	3-12
PL1	Power Meter Leveling	3-9
RCL	Recall Front Panel Setup	3-14
RF0	RF Off	3-9
RF1	RF On	3-9
RL	Return to Local	3-14
RM1	RF Marker On	3-9
RSS	Reset Sweep	3-14
RST	Reset Front Panel	3-9
RT0	RF During Retrace Off	3-9
RT1	RF During Retrace On	3-9
SAV	Save Front Panel Setup	3-14
SE0	Syntax Error Mode Off	3-12
SE1	Syntax Error Mode On	3-12
SEC	Seconds Data Terminator	3-9
SH	Shift	3-9
SIZ	Increment Size	3-10
SQ0	SRQ Mode Off	3-12
SQ1	SRQ Mode On	3-12
STP	Step Sweep	3-10
STS	Step Select	3-10
SWT	Enter Sweep Time Parameter	3-9
TRS	Trigger Sweep	3-9
TST	Self-Test	3-9
UL0	Unleveled Condition Mode Off	3-12
UL1	Unleveled Condition Mode On	3-12
UP	Increment Selected Parameter	3-14
VM1	Video Marker On	3-9

*Group Execute Trigger

SECTION IV

PERFORMANCE VERIFICATION

4-1 INTRODUCTION

This section contains the performance verification procedures, which are organized as follows:

Para.	Test
4-3	FREQUENCY ACCURACY
4-4	SWEEP TIME
4-5	OUTPUT POWER
4-6	RESIDUAL AM
4-7	RESIDUAL FM
4-8	EXTERNAL FM AND PHASE LOCK
4-9 thru 4-11	RF OUTPUT SIGNAL

4-2 RECOMMENDED TEST EQUIPMENT

A listing of the test equipment required for performance verification and for calibration (Section V) is given in Table 4-1.

4-3 FREQUENCY ACCURACY TESTS

To verify the sweep generator's frequency accuracy, perform the steps in subparagraphs a. thru c. below. If any of the frequencies are found to be out of tolerance, perform the A5 Frequency Instruction adjustments in paragraph 5-6 and the applicable Frequency Calibration adjustments in paragraph 5-9.

a. CW Frequency Accuracy

1. Connect the test equipment as shown in Figure 4-1, and turn the equipment on.

2. Press RESET on the sweep generator (sweeper).

3. Press CW F1.

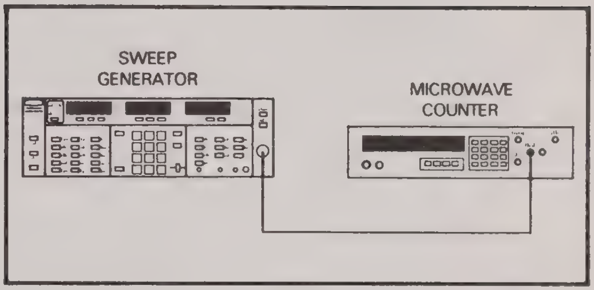


Figure 4-1. Test Equipment Setup for Frequency Accuracy Tests

4. For all models except the 6642A: Verify that F1 is accurate to within ±10 MHz (±20 MHz for the 6653A and 6659A) at the following frequencies:
   (a) Low end of the frequency range.
   (b) High end of the frequency range.
   (c) Each applicable bandswitch point ±50 MHz (that is, 1.950 & 2.050 GHz, 7.950 & 8.050 GHz, 12.350 & 12.450 GHz, and 17.950 & 18.050 GHz).
   (d) Each 1 GHz of tuning.

5. For the 6642A: Verify that F1 displays the following accuracies:
   (a) ±15 MHz – for the low end of the frequency range and each 1 GHz of tuning up to 26.000 GHz.
   (b) ±20 MHz – at 26.550 GHz and each 1 GHz of tuning up to 40 GHz.

6. Press RESET.

7. Sequentially press CW F0, CW F2, CW M1, and CW M2; verify that each CW parameter indicates its RESET frequency (Table 4-2).

Table 4-1. Recommended Test Equipment for Performance Verification and Calibration

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MANUFACTURER
Digital Multimeter	DC Volts: .05% to 30V, .002% to 10V. 5-1/2 digit resolution.	Keithley Model 191
Oscilloscope	60 MHz bandwidth. 1 mV sensitivity.	Tektronix 5440/5A481/5B42
Function Generator	300 mV to 10V output. 10 kHz square wave. 10 kHz sine wave.	HP 3311A
Microwave Counter	10 MHz to 26.5 GHz range. 0.25 MHz accuracy.	EIP Model 548
RF Power Meter	10 MHz to 26.5 GHz freq. range. +13 dBm measurement capability.	HP 435A, with .01-18 GHz 8481A Power Sensor
Spectrum Analyzer, with External Mixer	60 dB power range. 10 MHz to 40 GHz freq. range. IF output. 50 dB signal-to-noise ratio, .01 to 2 GHz.	HP 8565A, HP 11517A Mixer, HP 11519A Adapter (18-26.5 GHz), HP 11520A Adapter (26.5-40 GHz)
Modulation Meter	15 kHz bandwidth. 1 kHz sensitivity.	Marconi TF2304
True RMS Voltmeter	-60 dB sensitivity. 10 kHz bandwidth.	Fluke 8921A
Adjustable AC Line Transformer (Variac)	100/120V line voltage. 220/240V line voltage.	General Radio W5MTB, General Radio W10HM73
Line Voltage Monitor	120V line voltage. 240V line voltage.	RCA 120B RCA WV 503A
Scalar Network Analyzer	Frequency range: .01 to 26.5 GHz.	WILTRON Model 560 or 560A w/560-7S50 Opt. 2 Detector
RF Detector	Frequency range: .01 to 34 GHz.	WILTRON Model 70S50B

Table 4-1. Recommended Test Equipment for Performance Verification and Calibration (Continued)

INSTRUMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MANUFACTURER
Microwave Counter	18.0 to 40 GHz range. 0.25 MHz accuracy.	EIP Model 578, with 590 Frequency Extension Kit and Option 91 Remote Sensor
RF Power Meter	18.0 to 40 GHz range. +5 dBm measurement capability.	HP 432A, with K482A and R486A Thermistor Mounts
Waveguide Attenuator	18.0 to 40 GHz range. 20 dB attenuation.	HP R382A and K382A
Directional Coupler	18.0 to 40 GHz range.	HP R752C
RF Detector	26.5 to 40 GHz range.	HP R422A
Network Analyzer Cable	Connect BNC female detector output to 560A Scalar Network Analyzer.	560A-10BX
Power Supply	0-5 Vdc.	HP 6821

Table 4-2. Reset (Default) Settings for Numeric Parameters

All Models:
SWEEP TIME: 50 ms
LEVEL: Maximum Leveled Power (Table 1-1)
ΔF: 1000 MHz

	Model: 6609A	**Model: 6621A**	**Model: 6629A**	**Model: 6637A**
F1:	10 MHz	2000 MHz	8000 MHz	2000 MHz
F2:	2000 MHz	12000 MHz	18000 MHz	18000 MHz
F0:	1000 MHz	9000 MHz	13000 MHz	10000 MHz
M1:	500 MHz	3000 MHz	9000 MHz	3000 MHz
M2:	1500 MHz	11000 MHz	17000 MHz	17000 MHz

	Model: 6617A	**Model: 6621A-40**	**Model: 6629A-40**	**Model: 6637A-40**
F1:	10 MHz	2000 MHz	8000 MHz	2000 MHz
F2:	8000 MHz	12000 MHz	18000 MHz	20000 MHz
F0:	4000 MHz	9000 MHz	13000 MHz	11000 MHz
M1:	3000 MHz	3000 MHz	9000 MHz	3000 MHz
M2:	7000 MHz	11000 MHz	17000 MHz	19000 MHz

(continued)

Table 4-2. Reset (Default) Settings for Numeric Parameters (continued)

All Models:
SWEEP TIME: 50 ms
LEVEL: Maximum Leveled Power (Table 1-1)
ΔF: 1000 MHz

Model 6638A

F1: 2000 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 17000 MHz

Model: 6647A

F1: 10 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 1000 MHz
M2: 17000 MHz

Model: 6653A

F1: 2000 MHz
F2: 26000 MHz
F0: 14000 MHz
M1: 3000 MHz
M2: 25000 MHz

Model: 6659A

F1: 10 MHz
F2: 26000 MHz
F0: 13000 MHz
M1: 3000 MHz
M2: 25000 MHz

Model: 6642A

F1: 18000 MHz
F2: 40000 MHz
F0: 25000 MHz
M1: 19000 MHz
M2: 39000 MHz

Model: 6648A

F1: 10 MHz
F2: 20000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 19000 MHz

b. Sweep Frequency Accuracy Tests

1. Press FREQUENCY RANGE ΔF F0.

2 Press ΔF and set for 0.050 GHz.

3. Press F0.

4. For all models other than the 6609A: In turn set F0 to the midfrequency of each applicable YIG band (5, 10, 15, and 22 GHz; or for the 6642A, 22 and 33 GHz) and verify swept-frequency accuracy, as follows:

   (a) Press MANUAL SWEEP.

   (b) Rotate the MANUAL SWEEP control fully counterclockwise.

   (c) Verify that the counter reads 25 MHz below the F0 frequency, with an accuracy as specified in Table 4-3.

   (d) Rotate the MANUAL SWEEP control fully clockwise.

   (e) Verify that the counter reads 25 MHz above the F0 frequency, with the accuracy specified in Table 4-3.

5. For the 6609A only:

   (a) Set ΔF F0 to 1 GHz.

   (b) Using steps 4a thru 4e above, verify the swept-frequency accuracy.

Table 4-3. Swept-Frequency Accuracy Specifications

FREQUENCY (MHz)	MODEL
± 15	All models except 6642A, 6653A, and 6659A
± 30	6653A and 6659A
± 25	6642A, frequencies 26.5 GHz and below
± 30	6642A, frequencies above 26.5 GHz

c. Frequency Vernier Accuracy Tests

1. Press RESET.
2. Press CW F0.
3. Record the counter's frequency readout.
4. Press FREQUENCY VERNIER INCREASE and hold depressed until the frequency stops increasing.
5. Verify that the counter's frequency readout increased by ≥12 MHz (≥25 MHz for the 6642A, 6653A and 6659A) from the frequency recorded in step 3.
6. Press FREQUENCY VERNIER OFF.
7. Press FREQUENCY VERNIER DECREASE and hold depressed until the frequency stops decreasing.
8. Verify that the counter's frequency readout decreased by ≥12 MHz (≥25 MHz for the 6642A, 6653A, and 6659A) from the frequency recorded in step 3.

4-4 SWEEP TIME TEST

To verify the sweep generator's sweep time, perform the steps below. If the sweep time is found to be out of tolerance, perform the A2 Ramp Generator Adjustments in paragraph 5-5.

a. Connect the test equipment as shown in Figure 4-2, and turn the equipment on.

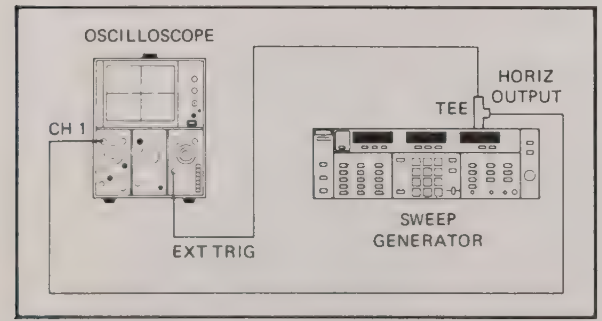


Figure 4-2. Test Equipment Setup for Sweep Time Test

b. Press RESET on the sweep generator.

c. Press FREQUENCY RANGE ΔF F0.

d. Press SWEEP TIME and set for 10 ms.

e. Verify that the oscilloscope displays a 10 ms ±2.0 ms ramp, as shown in Figure 4-3.

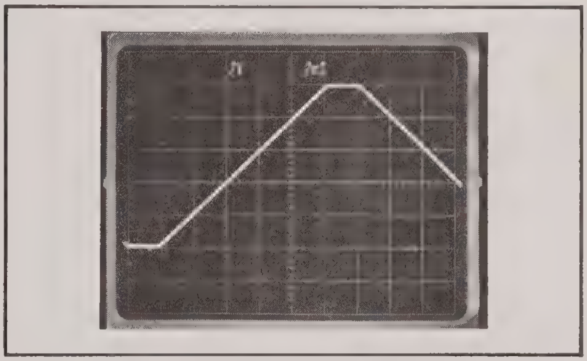


Figure 4-3. A2 Sweep Ramp, 10 ms Sweep

f. Press SWEEP TIME and set for 1 second.

g. Verify that the oscilloscope displays a 1 ±0.2 second ramp, as shown in Figure 4-4.

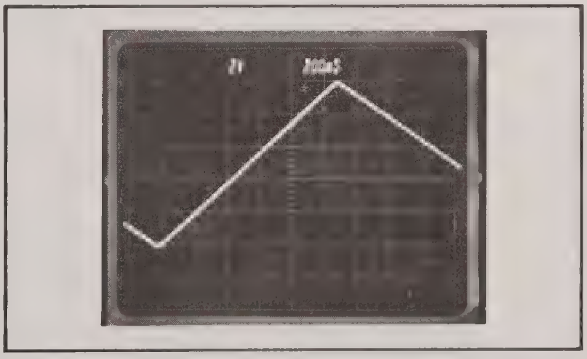


Figure 4-4. A2 Sweep Ramp, 1 s Sweep

h. Press SWEEP TIME and set for 10 seconds.

i. Verify that the oscilloscope displays a 10 ±2 second ramp.

4-5 OUTPUT POWER TESTS

For all models except the 26.5 to 40 GHz band of the 6642A, verify the output power level as described below. If the output power level is found to be out of tolerance, perform the ALC Calibration adjustments in paragraph 5-14.

NOTE

The 26.5 to 40 GHz band of the 6642A is not internally leveled.

a. Connect the test equipment as shown in Figure 4-5, and turn the equipment on.

b. Press RESET on the sweep generator (sweeper).

c. Verify that the RF SLOPE control is OFF.

d. Press LEVELING – DETECTOR.

e. On the network analyzer, adjust CHANNEL A OFFSET control to position the trace's minimum power point on the center graticule line; see Figure 4-6.

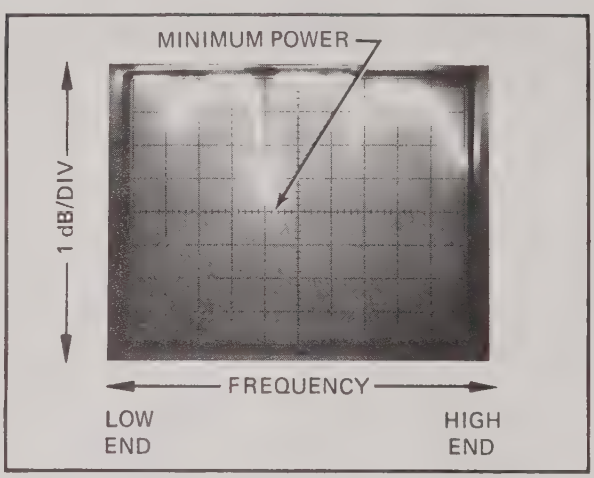
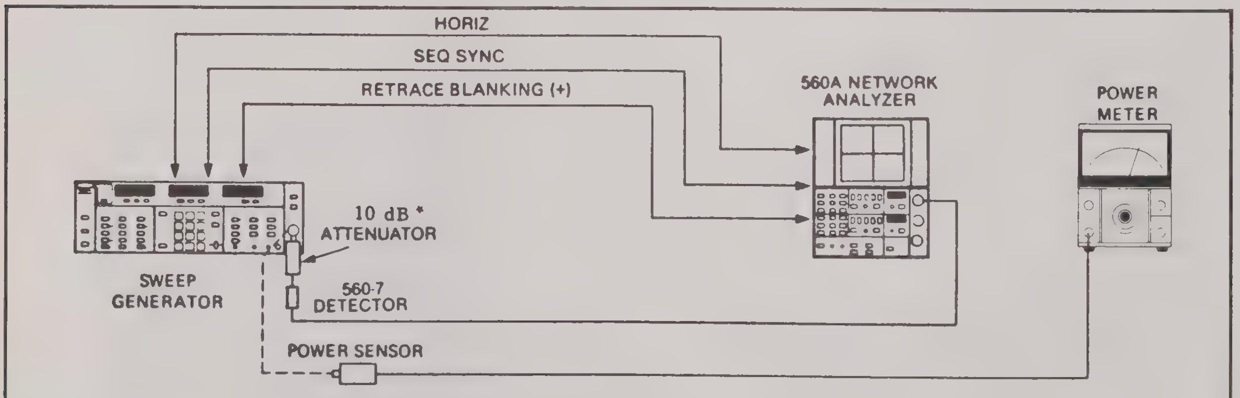

MINIMUM POWER
1 dB/DIV
FREQUENCY
LOW END
HIGH END

Figure 4-6. Unleveled Power

f. Verify that the OFFSET dB display reads at least 0.2 dBm greater than the sweeper's output level, as indicated on the LEVEL LED display.

g. On the sweeper, press LEVELING – INTERNAL.

h. On the network analyzer, press CHANNEL A .5 dB PER DIVISION.


HORIZ
SEQ SYNC
RETRACE BLANKING (+)
560A NETWORK ANALYZER
POWER METER
10 dB *
ATTENUATOR
SWEEP GENERATOR
560-7 DETECTOR
POWER SENSOR

*Use with 6609A, 6617A, 6647A, 6648A, 6659A, 6621A-40, 6629A-40, 6637A-40.

560/560A Control Settings

CHANNEL A ON: On
INPUT: A
MEMORY: Off
dB PER DIVISION: 1
REFERENCE dB/dBm: dBm

REFERENCE POSITION
LOCATE: Center graticule line
OFFSET dB: As appropriate

CHANNEL B ON: Off
REFRESH: On

MARKERS: Off
SMOOTHING: Off

560A Only

HORIZ SEL (rear panel): 10
Z AXIS SEL (rear panel): INT

Figure 4-5. Test Equipment Setup for Output Power Tests

i. Verify that the peak-to-peak ripple (Figure 4-7) on the network analyzer trace is as shown in Table 4-4.

Table 4-4. Power Accuracy, Peak-to-Peak Ripple

MODEL	PK-PK ACCURACY (dB)	OPT. 2 PK-PK ACCURACY (dB)
6609A	1.2	1.9
6617A	1.4	2.2
6621A	1.4	3.0
6621A-40	1.4	3.0
6629A	1.4	3.2
6629A-40	1.4	3.2
6637A	1.4	3.2
6637A-40	1.4	3.2
6638A	1.4	3.2
6642A	2.2	--
6647A	1.6	3.2
6648A	1.6	3.2
6653A	2.2	3.2
6659A	2.2	3.2

j. Disconnect the detector from the sweeper, and connect the power sensor in its place.

NOTE

The unleveled output power of the 6621A-40, 6629A-40, 6637A-40, and .01-2 GHz heterodyne band on applicable models may exceed +23 dBm at some frequencies. Be advised that the maximum input power level of the HP 465 Power Meter is 300 mW (+23 dBm).

k. Press MANUAL SWEEP.

l. On the sweeper, press CW F0 and set F0 for the midrange frequency. Example: 1 GHz (6609A), 10 GHz (6637A), 22 GHz (6642A) etc.

m. Verify that the power meter reads the power level indicated on the sweeper's LEVEL LED display, ±0.2 dB.

n. For the 6653A and 6659A only:

   1. Set F0 for 23 GHz.
   2. Verify that the power meter reads the power level indicated on the sweeper's LEVEL LED display, ±0.2 dBm.
   3. Return F0 to the midrange frequency.

o. Press LEVEL and set the output power level first to 5 dB, then to 10 dB below the RESET power level, as indicated on the LEVEL LED display. At each setting, verify that the power meter reads the LEVEL display value, ±0.2 dB.

p. For the 6653A and 6659A only:

   1. Set F0 for 23 GHz.
   2. Repeat step o. above.
   3. Return F0 to midrange frequency.

q. For all models except the 6642A, press F0 and set for the high-end frequency.

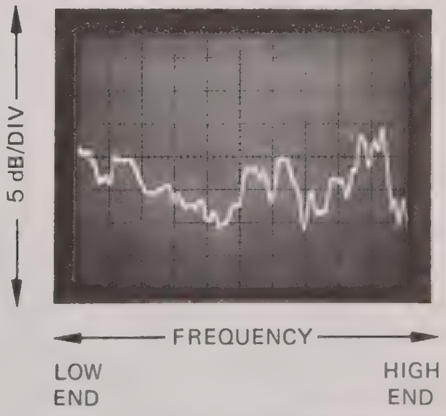


Figure 4-7. Leveled Power

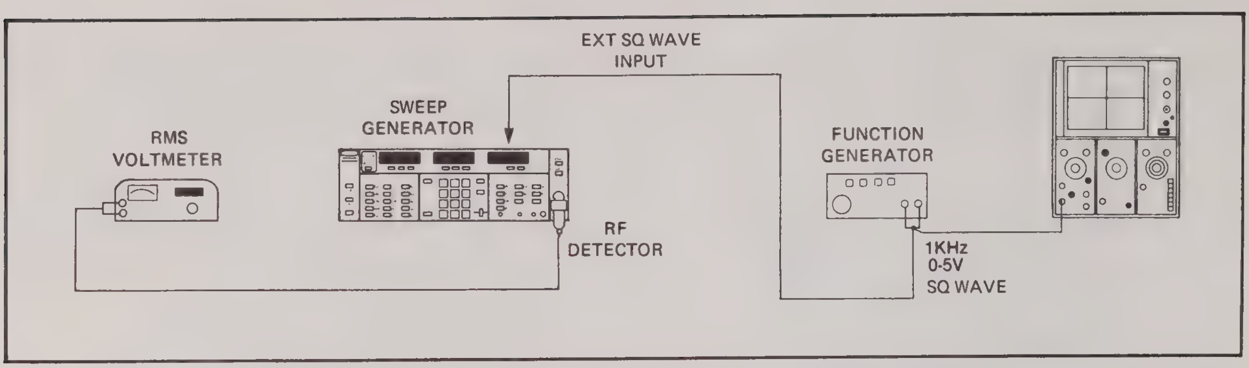

EXT SQ WAVE INPUT
SWEEP GENERATOR
RMS VOLTMETER
FUNCTION GENERATOR
RF DETECTOR
1KHz
0-5V
SQ WAVE

Figure 4-8. Test Equipment Setup for Residual AM Test

r. Record power meter reading.

s. Rotate RF SLOPE fully clockwise.

t. Verify that the power meter reading increases by ≈3 dB.

u. Return RF SLOPE to OFF.

4-6 RESIDUAL AM TEST

To verify that the residual amplitude modulation signals in the sweep generator are tolerable, perform the steps below. If the residual AM is found to be out of tolerance, contact WILTRON Customer Service.

a. Connect the test equipment as shown in Figure 4-8, and turn the equipment on.

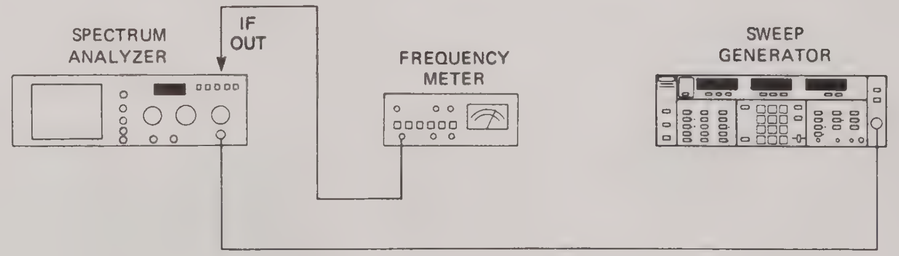
b. Press RESET on the sweep generator (sweeper).

c. Press CW F1 and set to the midrange frequency.

d. Record the RMS voltmeter reading.

e. Turn the function generator off.

f. Record the second RMS voltmeter reading.


SPECTRUM ANALYZER
IF OUT
FREQUENCY METER
SWEEP GENERATOR

Control Settings:

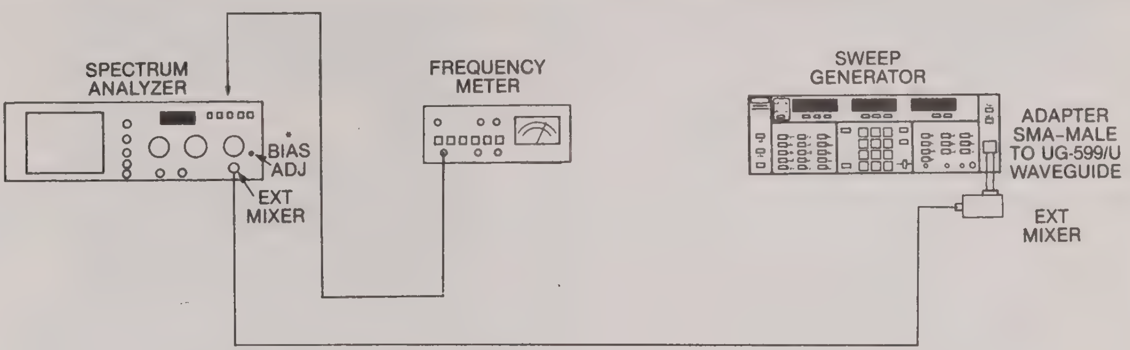
Frequency Meter

Supply: On
Deviation: X1
Other Controls:
0 dB
FM
+
5

Spectrum Analyzer

FREQUENCY BAND GHz: As appropriate
INPUT ATTEN: 20 dB
REFERENCE LEVEL: 20 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 50 MHz
RESOLUTION BW: 1 MHz (Coupled)
FREQUENCY SPAN MODE: PER DIV
SWEEP TIME/DIV: AUTO
SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: OFF
WRITE: On (Engaged)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: OFF (In)
TUNING: As appropriate

Figure 4-9. Test Equipment Setup for Residual FM Test, .01 to 20 GHz


SPECTRUM ANALYZER
*
BIAS ADJ
EXT MIXER
FREQUENCY METER
SWEEP GENERATOR
ADAPTER SMA-MALE TO UG-599/U WAVEGUIDE
EXT MIXER

* For each test frequency, readjust BIAS for maximum signal amplitude.

Control Settings:

Frequency Meter

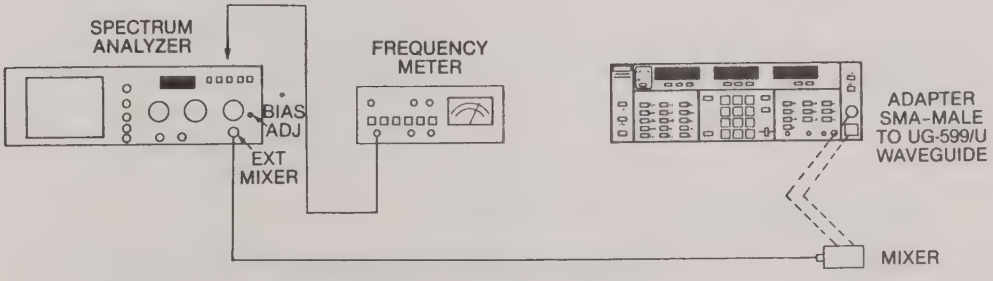
Supply: On
Deviation: X1
Other Controls:
0 dB
FM
+
5

Spectrum Analyzer

FREQUENCY BAND GHz: As appropriate
INPUT ATTEN: 10 dB
REFERENCE LEVEL: -35 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 500 MHz
RESOLUTION BW: 3 MHz (Coupled)
FREQUENCY SPAN MODE: PER DIV
SWEEP TIME/DIV: AUTO

SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: OFF
WRITE: On (Engaged)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: OFF (In)
TUNING: As appropriate

Figure 4-10. Test Equipment Setup for Residual FM Test, 18 to 26.5 GHz


SPECTRUM ANALYZER
*
BIAS ADJ
EXT MIXER
FREQUENCY METER
ADAPTER SMA-MALE TO UG-599/U WAVEGUIDE
MIXER

* For each test frequency, readjust BIAS for maximum signal amplitude.

Control Settings:

Frequency Meter

Supply: On
Deviation: X1
Other Controls:
0 dB
FM
+
5

Spectrum Analyzer

FREQUENCY BAND GHz: As appropriate
INPUT ATTEN: 10 dB
REFERENCE LEVEL: -35 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 500 MHz
RESOLUTION BW: 3 MHz (Coupled)
FREQUENCY SPAN MODE: PER DIV
SWEEP TIME/DIV: AUTO

SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: OFF
WRITE: On (Engaged)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: OFF (In)
TUNING: As appropriate

Figure 4-11. Test Equipment Setup for Residual FM Test, 18 to 40 GHz

g. Calculate the sweeper's residual AM per the following formula:

Residual AM (-dBc)* =

$$-\left[\left|\begin{matrix}\text{step d}\\ \text{reading}\end{matrix}\right| + \left|\begin{matrix}\text{step f}\\ \text{reading}\end{matrix}\right| + 9\text{ dB}\right].$$

* dB below the carrier.

h. Residual AM should be less than -50 dBc.

i. Turn the function generator back on.

j. Repeat steps c. thru h. for the midfrequency in each applicable frequency band (1 GHz (Het. Band); 5 GHz (YIG 1 Band); 10 GHz (YIG 2 Band); 15 GHz (YIG 3 Band); 22.25 GHz (YIG 4 Band); or for 6642A, 22.25 GHz (YIG 1 Band) and 33.25 GHz (YIG 2 Band)).

4-7 RESIDUAL FM TEST

To verify that the residual frequency modulation signals in the sweep generator are tolerable, perform the steps below. If the residual FM is found to be out of tolerance, contact WILTRON Customer Service.

a. Connect the test equipment as shown in Figure 4-9, 4-10, or 4-11 as applicable.

b. Using the following procedure, check residual FM at each applicable frequency in Table 4-5.

1. On the sweep generator (sweeper), press CW F0 and set for the desired frequency.

2. On the spectrum analyzer:

   (a) Adjust TUNING to center the sweeper's output frequency on the CENTER FREQUENCY graticule line.

   (b) Adjust REFERENCE LEVEL to place the top of the waveform on the REFERENCE LEVEL graticule line.

   (c) Observe the display; it should resemble Figure 4-12.

   (d) Press ZERO SPAN and readjust TUNING to place the trace on the REFERENCE LEVEL graticule line (Figure 4-13).

Table 4-5. Residual FM Test Frequencies

FREQUENCY (GHz)	MODEL
.05	6609A, 6617A, 6647A, 6648A, 6659A
1.8	Same as above.
7.8	6617A, 6621A, 6621A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A
12.2	6621A, 6621A-40, 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A
17.8	6653A, 6659A
18.6	6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6642A, 6647A, 6648A
20	6638A, 6648A
26.5	6642A, 6653A, 6659A
40	6642A

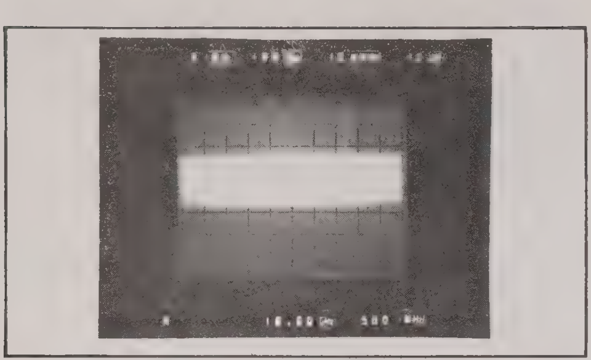


Figure 4-12. Sweeper's Frequency At 500 MHz/Division FREQUENCY SPAN

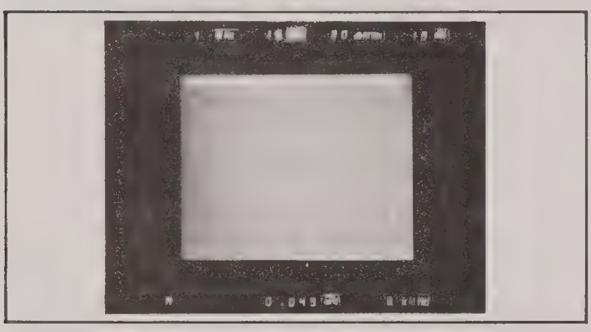


Figure 4-13. Spectrum Analyzer ZERO SPAN Display

(e) Position AUTO STABILIZER to ON; if necessary, readjust the TUNING control to place the trace on the REFERENCE LEVEL graticule line.

3. On the modulation meter, after ensuring the HIGH and LOW indicators are not lit, read the frequency deviation meter. The meter should indicate as shown in Table 4-6.

NOTE

Increase REFERENCE LEVEL setting as necessary to ensure that LOW LEVEL indicator goes out.

4-8 EXTERNAL FM AND PHASE-LOCK TEST

To verify that the sweep generator provides the correct -6 MHz/V frequency deviation for an input FM or phase-lock signal, perform the steps below. If the FM Sensitivity specification is found to be out of tolerance, contact WILTRON Customer Service.

a. Set up the test equipment as shown in Figure 4-14 and turn the equipment on.

b. Adjust the power supply for a DVM reading of -4V ±0.04 volts.

Table 4-6. Residual FM Specifications

MODEL	SPECIFICATION (kHz) (30 Hz to 15 kHz BW)
6609A, 6617A	7
6621A, 6621A-40, 6629A, 6629A-40	10
6637A, 6637A-40, 6638A, 6647A, 6648A	7, below 8 GHz 10, below 8 GHz
6653A, 6659A	7, below 8 GHz 10, 8 to 18 GHz 15, above 18 GHz
6642A	30, below 26.5 GHz 40, above 26.5 GHz

c. On the sweep generator:

   1. Press RESET.

   2. Press CW F0.

   3. Press and hold the appropriate FREQUENCY VERNIER pushbutton until the counter reads the F0 frequency ±100 kHz (±200 kHz for the 6642A, 6653A, or 6659A).

   4. Press FM AND PHASELOCK.

d. Verify that the counter's frequency readout increased by 24 ±2.4 MHz.

e. Readjust the power supply for a DVM reading of +4 ±0.04 volts.

f. Verify that the counter's frequency readout decreased by 24 ±2.4 MHz.

4-9 RF OUTPUT SIGNAL TESTS, ALL MODELS EXCEPT 6642A, 6653A, AND 6659A

To verify that the sweep generator's RF output signal meets the harmonic, spurious, purity, and frequency-pulling specifications, perform the steps in subparagraphs a. thru d. below. If any of the output-signal tests are found to be out of tolerance, contact WILTRON Customer Service.

a. 2nd Harmonic Attenuation Tests

   1. Connect the test equipment as shown in Figure 4-15 and turn the equipment on.

   2. On the sweep generator (sweeper):

      (a) Press SHIFT then CW RAMP to off (rear panel HORIZ OUTPUT DURING CW switch to OFF for 6600 models).

      (b) Press RESET.

      (c) Press CW F1.

   3. On the spectrum analyzer, adjust TUNING to position the sweeper's fundamental frequency near the CENTER FREQUENCY graticule line.

   4. While observing the spectrum analyzer's display,

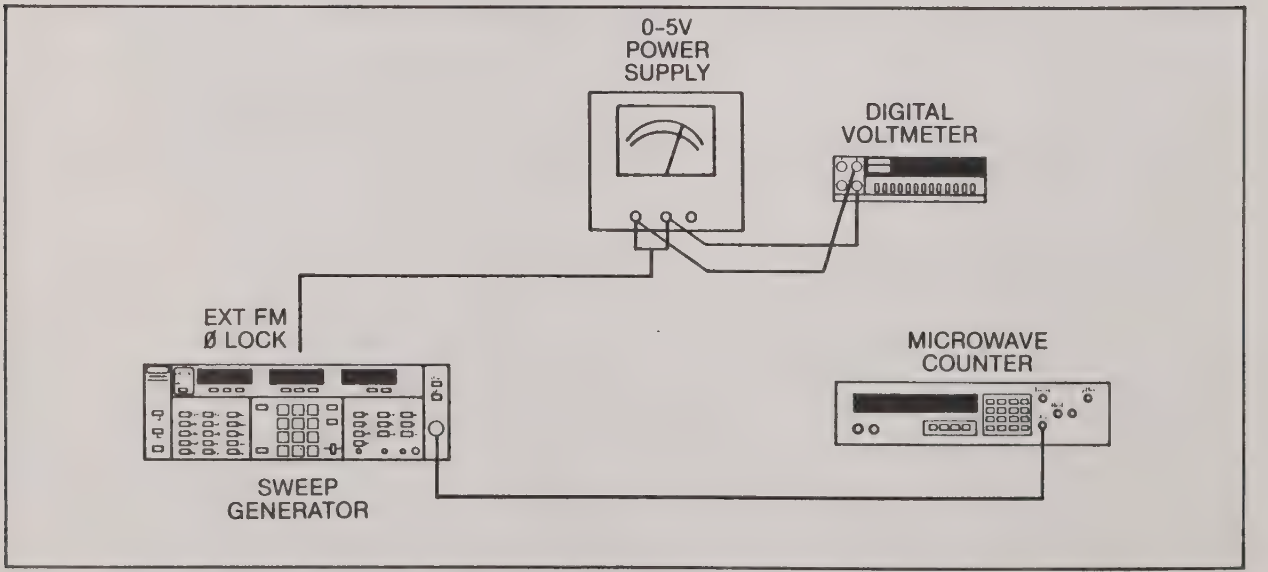
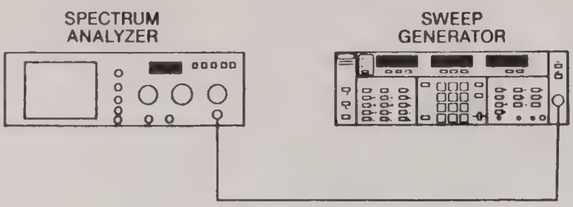


Figure 4-14. Test Equipment Setup for FM Deviation Test



Spectrum Analyzer Control Settings

FREQUENCY BAND: As appropriate
RESOLUTION BW: 1 MHz
REF LEVEL: 10 dBm
INPUT ATTN: As appropriate
FREQUENCY SCAN/DIV: As appropriate
FREQ SPAN MODE: PER DIV
LOG SCALE: 10 dB
SWEEP SOURCE: INT
SWEEP TRIGGER: FREE RUN
SWEEP TIME/DIV: AUTO

Figure 4-15. Test Equipment Setup for RF Output Signal Tests

(a) move the sweeper's INCREASE/DECREASE lever toward INCREASE, so that the displayed signals move slowly upward in frequency, and

(b) at the same time, adjust the spectrum analyzer's TUNING control clockwise to keep the 2nd harmonic on screen.

NOTE

Change the spectrum analyzer's FREQUENCY RANGE setting as necessary in order to observe the sweep generator's entire frequency range.

5. Verify that the applicable 2nd harmonic is attenuated as shown below, except for the 6621A40, 6629A-40, and 6637A-40. For these models, the 2nd harmonic is attenuated to -25 dBc..

FREQUENCY	ATTENUATION
.01 - 2 GHz	-30 dBc
2 - 20 GHz	-40 dBc

b. Spurious Signal Test

1. On the sweeper, move the INCREASE/DECREASE lever to maximum DECREASE, and return F1 to the low-end frequency.

2. On the spectrum analyzer:

   (a) Press FREQUENCY BAND as appropriate to display low-end frequency.

   (b) Adjust TUNING for the sweeper's low-end frequency.

3. While observing the spectrum analyzer for non-harmonically-related (spurious) signals, move the sweeper's INCREASE/DECREASE lever toward INCREASE.

4. Verify that spurious signals, if present, are <-40 dBc for the .01-2 GHz band and <-60 dBc for the remaining 2 to 18.6 (or 20) GHz frequency range.

NOTE

Spurious signals may be generally characterized as follows: They will (1) be weak in power, (2) "pop up" abruptly and track oppositely to the fundamental and harmonic signals, and (3) disappear abruptly. An example of a spurious response at 984 MHz is shown in Figure 4-16.

c. Signal Purity Test

1. On the sweeper, press CW F1 and set

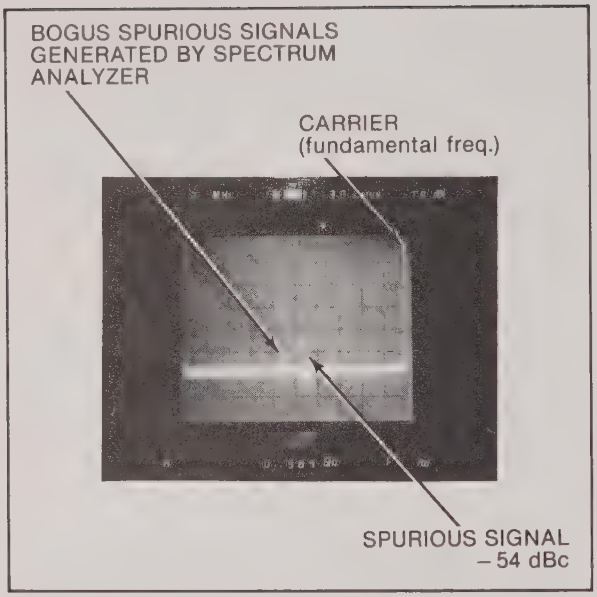

BOGUS SPURIOUS SIGNALS GENERATED BY SPECTRUM ANALYZER
CARRIER (fundamental freq.)
SPURIOUS SIGNAL – 54 dBc

Figure 4-16. Example of a Spurious Signal

for 0.050 GHz (6609A); 8.050 GHz (6629A/6629A-40); or 2.050 GHz (all other models).

2. On the spectrum analyzer:
   - (a) Press FREQUENCY BAND as appropriate to display the step 1. frequency.
   - (b) Adjust FREQUENCY SPAN/DIV for 100 kHz (coupled).
   - (c) Adjust TUNING to center the sweeper's fundamental frequency on the CENTER FREQUENCY graticule line, as shown in Figure 4-17.
   - (d) Set VIDEO FILTER to .03.

3. Verify that the noise sidebands located 100 kHz away from the sweeper's fundamental frequency are <-60 dBc.

4. Repeat the Signal Purity Test for the following frequencies, as applicable:
   - (a) 8.05 GHz
   - (b) 12.35 GHz
   - (c) 12.45 GHz
   - (d) 18.6 GHz
   - (e) 20.0 GHz

d. Frequency Pulling Test

1. On the sweeper:
   - (a) Press CW F0 and set for 0.050 GHz (6609A), 8.050 GHz (6629A/6629A-40), or 2.050 GHz (all other models).
   - (b) Press LEVEL and set as shown below:

Model	Power Level (dBm)
6609A	+13
6621A-40, 6629A-40, 6637A-40	+16
All Others	+10

2. On the spectrum analyzer,
   - (a) press FREQUENCY BAND as appropriate to display the step 1(a) frequency;
   - (b) adjust FREQUENCY SPAN/DIV to 100 kHz (coupled);
   - (c) adjust TUNING to center the sweeper's fundamental frequency on the CENTER FREQUENCY graticule line.

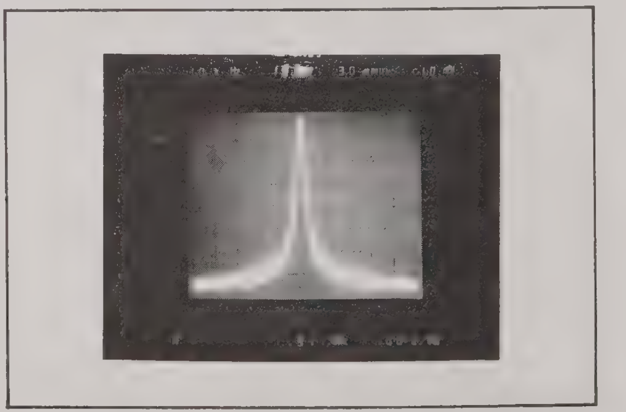


Figure 4-17. Noise Sidebands

3. On the sweeper, press LEVEL and set as shown below:

Model	Power Level (dBm)
6609A	+3
6621A-40, 6629A-40, 6637A-40	+6
All Others	0

4. On the spectrum analyzer, verify that the displayed signal moved less than ±500 kHz.

NOTE

The waveform photograph in Figure 4-18 shows a representative frequency shift. The photograph is a double exposure: the first exposure is the signal at 10 dBm and the second is the same signal at 0 dBm.

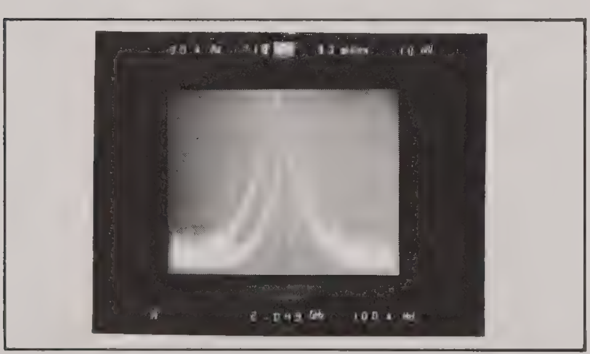


Figure 4-18. Example of Frequency Pulling

5. Repeat the Frequency Pulling test for the following frequencies, as applicable:
   (a) 8.05 GHz
   (b) 12.35 GHz
   (c) 12.45 GHz
   (d) 18.6 GHz
   (e) 20.0 GHz

4-10 RF OUTPUT SIGNAL TESTS, MODEL 6642A

To test the sweep generator's RF output for (1) spurious signals, (2) signal purity 100 kHz above and below the carrier frequency, and (3) frequency pulling with a 10 dB power level change, perform the steps in subparagraphs a. thru c. below. If these tests indicate that the output signal is not within either the -60 dBc spurious or signal purity specification or the ±500 kHz frequency pulling specification, contact WILTRON Customer Service.

a. Spurious Signal Test

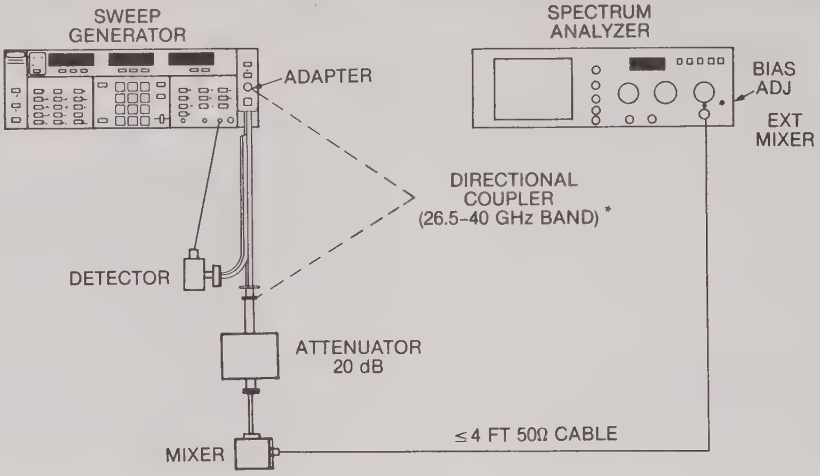
1. Connect the test equipment and position the controls as shown in Figure 4-19; turn the equipment on.

2. On the sweep generator (sweeper):
   (a) Press SHIFT then CW RAMP (set rear panel HORIZ ON DURING CW to OFF for 6600 models).
   (b) Press RESET.
   (c) Press CW F1.

3. On the spectrum analyzer:
   (a) Adjust TUNING to position the sweeper's frequency on the CENTER FREQUENCY graticule line.
   (b) Adjust EXT MIXER BIAS for maximum signal amplitude.
   (c) Adjust REFERENCE LEVEL to place the top of the waveform on the REFERENCE LEVEL graticule line.
   (d) The display should resemble Figure 4-20.

4. On the sweeper, press F1.

5. While observing the analyzer and operating the TUNING control to keep the sweeper's frequency on screen, operate the sweeper's IN-


SWEEP GENERATOR
ADAPTER
SPECTRUM ANALYZER
BIAS ADJ
EXT MIXER
DIRECTIONAL COUPLER (26.5-40 GHz BAND)*
DETECTOR
ATTENUATOR 20 dB
MIXER
≤4 FT 50Ω CABLE

*Directional coupler only used with 26.5 to 40 GHz band. For the 18-26.5 GHz band, connect the attenuator to the waveguide flange on the adapter.

Spectrum Analyzer Control Settings

FREQUENCY BAND GHz: as appropriate
INPUT ATTEN: 10 dB
REFERENCE LEVEL: -35 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 20 MHz
RESOLUTION BW: 300 kHz (Coupled)
FREQUENCY SPAN MODE: PER DIV

SWEEP TIME/DIV: AUTO
SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: .03
WRITE: On (In)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: On (out)
TUNING: as appropriate

Figure 4-19. Test Equipment Setup for RF Output Tests

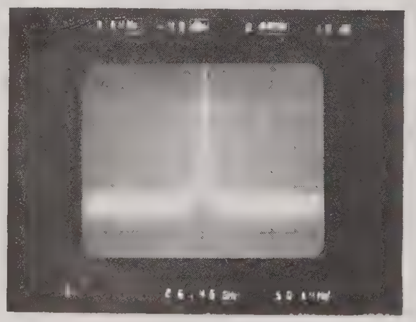


Figure 4-20. Analyzer Display, with 30 dB Signal-to-Noise Ratio

CREASE/DECREASE lever to slowly increase frequency to 26.5 GHz.

NOTE

Readjust EXT MIXER BIAS for peak signal amplitude each 500 MHz.

6. Ensure that no bonified spurious signals (that is, signals that pass the analyzer's SIG IDENT test) are present.

7. Remove the attenuator/mixer combination from the 18-26.5 GHz connector, and connect it to the directional coupler as shown in Figure 4-19.

8. On the sweeper, press LEVELING-DETECTOR and adjust EXT ALC GAIN to midrange.

9. Repeat steps 5 and 6 above for the 26.5 to 40 GHz band.

b. Signal Purity Test

1. Remove the attenuator/mixer combination from the directional coupler, and return it to the 18-26.5 GHz connector.

2. On the sweeper, operate the INCREASE/DECREASE lever to place the F1 frequency at 18 GHz.

3. On the spectrum analyzer:
   (a) Adjust FREQUENCY SPAN for 5 MHz per division.
   (b) Adjust TUNING to center the sweeper's frequency on the CENTER FREQUENCY graticule line.
   (c) Readjust FREQUENCY SPAN for 50 kHz per division. Move the control in incremental steps, and readjust TUNING control as necessary to keep the signal centered on the display.
   (d) Rapidly (so as to capture the signal while it is still in the center of the screen), perform the following steps:
      (1) rotate PERSIST fully clockwise;
      (2) press SWEEP TRIGGER-SINGLE;
      (3) press ERASE;
      (4) press SWEEP TRIGGER-START/RESTART;
      (5) press STORE.

4. A trace similar to the one shown in Figure 4-21 should be obtained. Ensure that no sidebands are present 100 kHz (2 divisions) on either side of the carrier frequency.

5. On the spectrum analyzer,
   (a) press WRITE;
   (b) rotate PERSIST fully counterclockwise;
   (c) press FREE RUN.

6. On the sweeper, set F1 for 26 GHz and repeat step 2.

7. Remove the attenuator/mixer combination from the 18-26.5 GHz connector, and reconnect it to the directional coupler.

8. Repeat steps 3 thru 5 at 26.5 and 40 GHz.

c. Frequency Pulling Test

1. Remove the attenuator/mixer combination from the directional coupler, and return it to the 18-26.5 GHz connector.

2. On the sweeper, press CW F1 and set for 18 GHz.

3. On the spectrum analyzer:
   (a) Rotate VIDEO FILTER to OFF.
   (b) Adjust FREQUENCY SPAN TO 100 kHz.

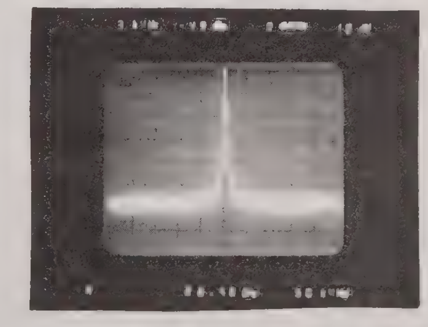


Figure 4-21. Noise Sidebands (6642A)

   (c) Adjust TUNING to center the sweeper's frequency on the display.

4. On the sweeper, press LEVEL and set for -5 dBm.

5. Ensure that the sweeper's frequency did not shift more than ±500 kHz.

6. Remove the attenuator/mixer combination from the 18-26.5 GHz connector, and reconnect it to the directional coupler.

7. On the sweeper, press CW F1 and set for 27 GHz.

8. On the analyzer, readjust TUNING to center the sweeper's frequency on the display.

9. On the sweeper, press LEVEL and set for -10 dBm.

NOTE

For the 26.5 to 40 GHz band the LEVEL LED readout does not indicate actual power unless the power level has been calibrated using a power meter. However, a reduction of 10 dB from the power level indicated on the LEVEL readout will result in an approximate 10 dB reduction in power, which can be verified on the spectrum analyzer.

10. Ensure that the sweeper's frequency did not shift more than ±500 kHz.

4-11 RF OUTPUT SIGNAL TESTS, MODELS 6653A AND 6659A

To verify that the sweep generator's RF output signal meets the harmonic, spurious, purity, and frequency-pulling specifications, perform the steps in subparagraphs a. thru d. below. If any of the output-signal tests are found to be out of tolerance, contact WILTRON Customer Service.

a. 2nd Harmonic Attenuation Tests

1. Connect test equipment as shown in Figure 4-22 and turn the equipment on.

2. On the sweep generator (sweeper):

   (a) Press SHIFT then CW RAMP to off (set rear panel HORIZ OUTPUT DURING CW to OFF for 6600 models).

   (b) Press RESET.

   (c) Press CW F1.

3. On the spectrum analyzer, adjust TUNING to position the sweeper's fundamental frequency near the CENTER FREQUENCY graticule line.

4. While observing the spectrum analyzer's display,

   (a) move the sweeper's INCREASE/DECREASE lever toward INCREASE, so that the displayed signals move slowly upward in frequency, and

   (b) at the same time, adjust the spectrum analyzer's TUNING control clockwise to keep the 2nd harmonic on screen.

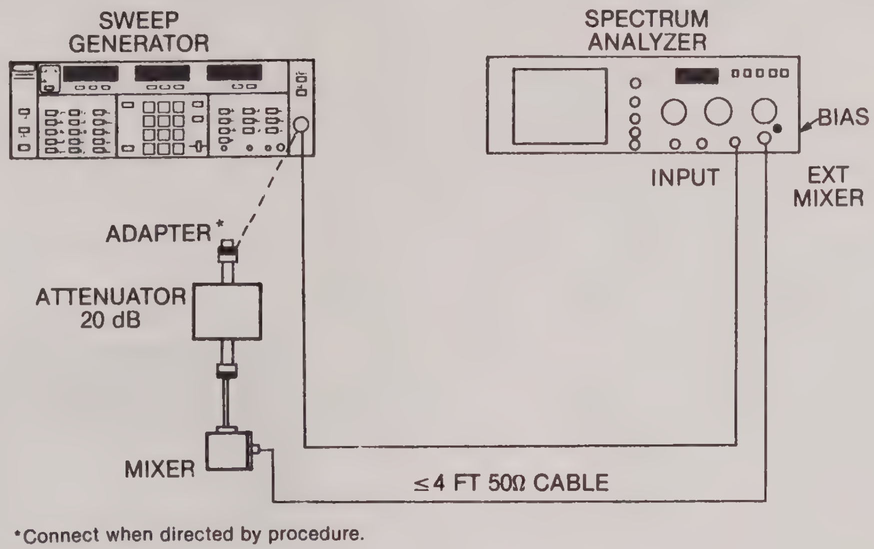
NOTE

Change the spectrum analyzer's FREQUENCY RANGE setting as necessary in order to observe the sweep generator's entire frequency range.

5. Stop frequency tuning at 20 GHz (6653A/6659A).

6. Verify that the applicable 2nd harmonic is attenuated as shown below.

FREQUENCY	ATTENUATION
.01 - 2 GHz	-30 dBc
2 - 26.5 GHz	-40 dBc


SWEEP GENERATOR
SPECTRUM ANALYZER
BIAS
INPUT
EXT MIXER
ADAPTER*
ATTENUATOR 20 dB
MIXER
≤4 FT 50Ω CABLE

*Connect when directed by procedure.

Spectrum Analyzer Control Settings

FREQUENCY BAND GHz: As appropriate
INPUT ATTEN: 20 dB
REFERENCE LEVEL: 10 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 500 MHz
RESOLUTION BW: 3 MHz (Coupled)
FREQUENCY SPAN MODE: PER DIV
SWEEP TIME/DIV: AUTO
SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: OFF
WRITE: On (Engaged)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: OFF (In)
TUNING: As appropriate

Figure 4-22. Test Equipment Setup for RF Output Tests, Models 6653A and 6659A

b. Spurious Signal Test

1. On the sweeper, move the INCREASE/DECREASE lever to maximum DECREASE, and return F1 to the low-end frequency.

2. On the spectrum analyzer:

   (a) Press FREQUENCY BAND .01-1.8 GHz (or 1.7-4.1 GHz).

   (b) Adjust TUNING for sweeper's low-end frequency.

3. While observing the spectrum analyzer for non-harmonically-related (spurious) signals, move the

sweeper's INCREASE/DECREASE lever toward INCREASE.

4. Verify that spurious signals, if present, are <-40 dBc for the .01-2 GHz band, and <-60 dBc for the remaining 2 to 18.0 GHz frequency range.

NOTE

Spurious signals may be generally characterized as follows: they will (1) be weak in power, (2) "pop up" abruptly and track oppositely to the fundamental and harmonic signals, and (3) disappear abruptly. An example of a spurious response at 984 MHz is shown in Figure 4-23.

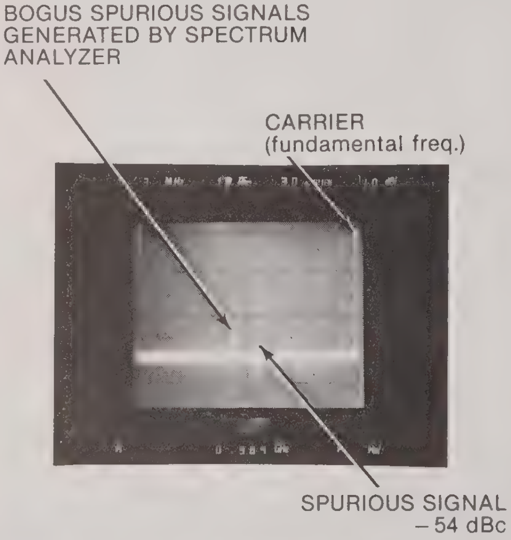

BOGUS SPURIOUS SIGNALS GENERATED BY SPECTRUM ANALYZER
CARRIER (fundamental freq.)
SPURIOUS SIGNAL – 54 dBc

Figure 4-23. Example of a Spurious Signal

5. Remove the cable from the RF OUTPUT connector, and connect the attenuator/mixer combination in its place.

6. On the spectrum analyzer:

   (a) Adjust TUNING to position the sweeper's frequency on the CENTER FREQUENCY graticule line.

   (b) Adjust EXT MIXER BIAS for maximum signal amplitude.

   (c) Adjust REFERENCE LEVEL to place the top of the waveform on the REFERENCE LEVEL graticule line.

   (d) The display should resemble Figure 4-24.

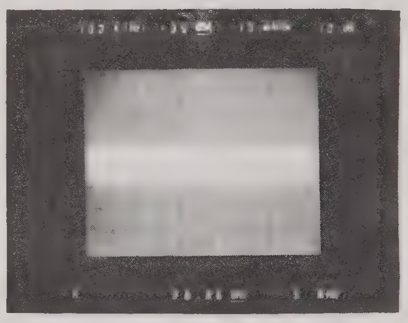


Figure 4-24. Analyzer Display, With 30 dB Signal-To-Noise Ratio

7. On the sweeper, press F1.

8. While observing the analyzer and operating the TUNING control to keep the sweeper's frequency on the screen, operate the sweeper's INCREASE/DECREASE lever to slowly increase the frequency to 26.5 GHz.

NOTE

Readjust EXT MIXER BIAS for peak signal amplitude each 500 MHz.

9. Ensure no bonified spurious signals (that is, signals that pass the analyzer's SIG IDENT test) are present.

c. Signal Purity Test

1. Remove the attenuator/mixer combi-

nation from the RF OUTPUT connector, and replace it with the test cable.

2. On the sweeper, press CW F1 and set for 2.050 GHz.

3. On the spectrum analyzer:

    (a) Press FREQUENCY BAND 1.7-4.1 GHz.

    (b) Adjust FREQUENCY SPAN/DIV for 100 kHz.

    (c) Adjust RESOLUTION BW for 10 kHz.

    (d) Adjust TUNING to center the sweeper's fundamental frequency on the CENTER FREQUENCY graticule line, as shown in Figure 4-25.

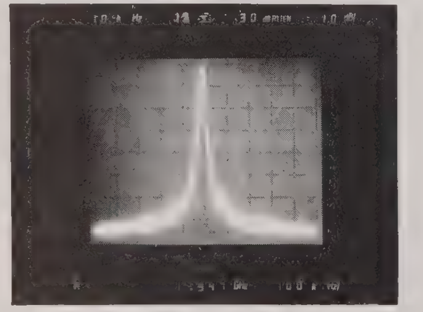


Figure 4-25. Noise Sidebands (≤18 GHz)

    (e) Adjust VIDEO FILTER to .03.

4. Verify that the noise sidebands located 100 kHz away from the sweeper's fundamental frequency are <-60 dBc.

5. Repeat the Signal Purity Test for the following frequencies:

    (a) 8.05 GHz

    (b) 12.35 GHz

    (c) 12.45 GHz

    (d) 18.0 GHz

6. Remove the test cable from the RF OUTPUT connector, and replace it with the attenuator/mixer combination.

7. On the sweeper, operate the INCREASE/DECREASE lever to place the F1 frequency at 26.0 GHz.

8. On the spectrum analyzer:

    (a) Adjust FREQUENCY SPAN for 5 MHz.

    (b) Adjust TUNING to center the sweeper's frequency on the CENTER FREQUENCY graticule line.

    (c) Readjust FREQUENCY SPAN for 50 kHz. Move the control in incremental steps, and readjust TUNING as necessary to keep the signal centered on the display.

    (d) Rapidly (so as to capture the signal while it is still in the center of the screen), perform the following steps:

        (1) rotate PERSIST fully clockwise;

        (2) press SWEEP TRIGGER-SINGLE.

        (3) press ERASE;

        (4) press SWEEP TRIGGER-START/RESTART;

        (5) press STORE.

9. A trace similar to the one shown in Figure 4-26 should be obtained. Ensure that no sidebands are present 100 kHz (2 division) on either side of the carrier frequency.

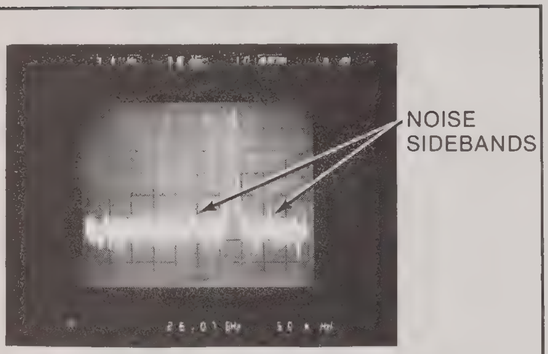


Figure 4-26. Noise Sidebands (>18.0 GHz)

10. On the analyzer:
    (a) Press WRITE.
    (b) Rotate PERSIST fully counterclockwise.
    (c) Press FREE RUN.
11. On the sweeper, press CW F2 and repeat step 8.

d. Frequency Pulling Test

1. Remove the attenuator/mixer combination from the RF OUTPUT connector, and replace it with the test cable.

2. On the sweeper:
    (a) Press CW F0 and set for 2.050 GHz.
    (b) Press LEVEL and set for +10 dBm.

3. On the spectrum analyzer:
    (a) Press FREQUENCY BAND 1.7-4.1 GHz.
    (b) Adjust FREQUENCY SPAN/DIV to 100 kHz.
    (c) Adjust RESOLUTION BW for 30 kHz.
    (d) Adjust TUNING to center the sweeper's fundamental frequency on the CENTER FREQUENCY graticule line.

4. On the sweeper, press LEVEL and set for 0 dBm.

5. On the spectrum analyzer, verify that the displayed signal moves less than ±500 kHz.

NOTE

The waveform photograph in Figure 4-27 shows a representative frequency shift. The photograph is a double exposure: the first exposure is the signal at 100 dBm and the second is the same signal at 0 dBm.

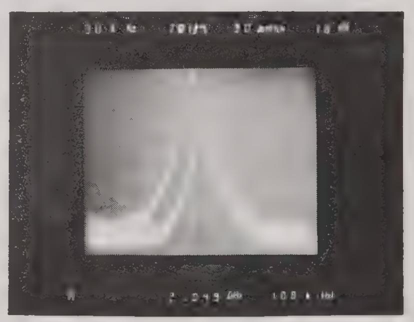


Figure 4-27. Example of Frequency Pulling

6. Repeat the Frequency Pulling test for the following frequencies:
    (a) 8.05 GHz
    (b) 12.35 GHz
    (c) 12.45 GHz
    (d) 18.0 GHz

7. Remove the test cable from the RF OUTPUT connector, and replace it with the attenuator/mixer combination.

8. On the spectrum analyzer:
   (a) Rotate VIDEO FILTER to OFF.
   (b) Adjust FREQUENCY SPAN TO 100 kHz.
   (c) Adjust TUNING to center the sweeper's frequency on the display.
9. On the sweeper, press LEVEL and set for -6 dBm.
10. Ensure that the sweeper's frequency did not shift more than ±500 kHz.

SECTION V

CALIBRATION AND ADJUSTMENTS

5-1 INTRODUCTION

This section contains adjustment and calibration instructions, and is organized as follows:

Para.	Adjustment or Calibration
5-4	Power Supply
5-5	A2 Ramp Generator
5-6	A5 Frequency Instruction
5-7	A3 Marker Generator
5-8	A6-A9 YIG Driver
5-9	Frequency Calibration
5-10	Tracking Filter
5-11	Sweep Rate Compensation
5-12	ALC Loop Calibration

5-2 RECOMMENDED TEST EQUIPMENT

The test equipment recommended for calibration of the sweep generator is listed in Table 4-1.

5-3 ADJUSTMENTS FOLLOWING PCB OR COMPONENT REPAIR OR REPLACEMENT

Table 5-1 lists the adjustments that should be performed following the repair or replacement of PCBs and components.

5-4 POWER SUPPLY ADJUSTMENTS

This paragraph provides instructions for adjusting the +5V and -38V supplies and the OUT OF REG, HIGH LINE, and LOW LINE motherboard LEDs. These adjustments should be performed when (1) power supply troubles are suspected and (2) after maintenance on any of the A13/A14 power supply circuits has been performed. The test equipment setup for the adjustments in subparagraphs d. and e. is shown in Figure 5-1.

a. +5 Volt Adjustment

1. Remove the top, bottom, and right-side covers. Refer to paragraph 7-3.1 for instructions, if necessary.

CAUTION

If maintenance has been performed on the A13/A14 power supply, perform steps 2 thru 8; otherwise, proceed to step 9.

2. Remove the A1 (Option 3) and A2 thru A10 PCBs (Figure 5-2).

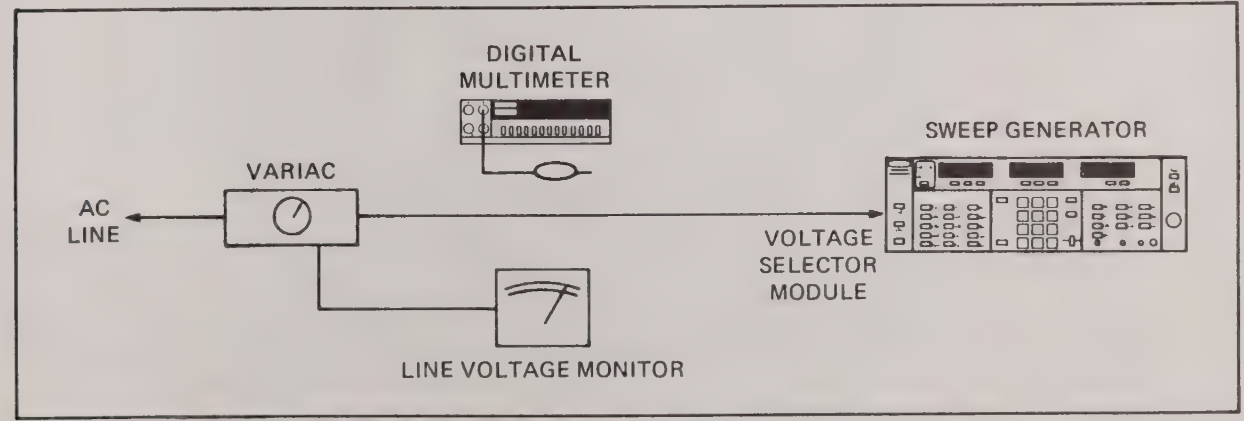


Figure 5-1. Test Equipment Setup for Low- and High-Line Adjustments

Table 5-1. Recommended Adjustments Following Repair Actions

IF A REPAIR OR REPLACEMENT ACTION WAS MADE TO:	PERFORM THE FOLLOWING ADJUSTMENTS IN PARAGRAPH(S):
A1 PCB	None
A2 PCB	5-5 thru 5-12
A3 PCB	5-7
A4 PCB	5-12
A5 PCB	5-6 & 5-9 thru 5-12
A6 PCB	5-6 thru 5-12
CAUTION After performing maintenance on the A6-A9 PCBs or installing a replacement YIG, check the bias before applying power to the YIG. Refer to paragraph 5-8.2.	
A7 PCB	5-6 thru 5-12
A8 PCB	5-6 thru 5-12
A10 PCB	5-6 & 5-9 thru 5-12
A11 PCB	None
A12 PCB	None
A13/A14 PCBs	5-4 thru 5-12
Osc 1 YIG	Same as for the A6 PCB.
Osc 2 YIG	Same as for the A7 PCB.
Osc 3 YIG	Same as for the A8 PCB.
PIN Switch, Coupler, or Down Converter	A4 Log Amplifier. (This adjustment requires specialized test equipment, available only at the factory.)

3. As applicable, disconnect the following A14 connectors (Figure 5-2): P5, P6, P7, P12, P13, P14, P16, P17, P20, P23, P27, and P30.

4. Clip a 1/2W fixed resistor, 50 to 100Ω, between the +5V and GND test points (Figure 5-3).

5. Attach the digital multimeter (DMM) test leads to the resistor installed in step 4 above.

6. Press POWER to ON, and adjust A13R6 (Figure 5-4) for approximately 5 volts.

7. Press POWER to OFF, and disconnect the resistor from P3.

8. Reconnect the PCBs and connectors disconnected in steps 2 and 3.

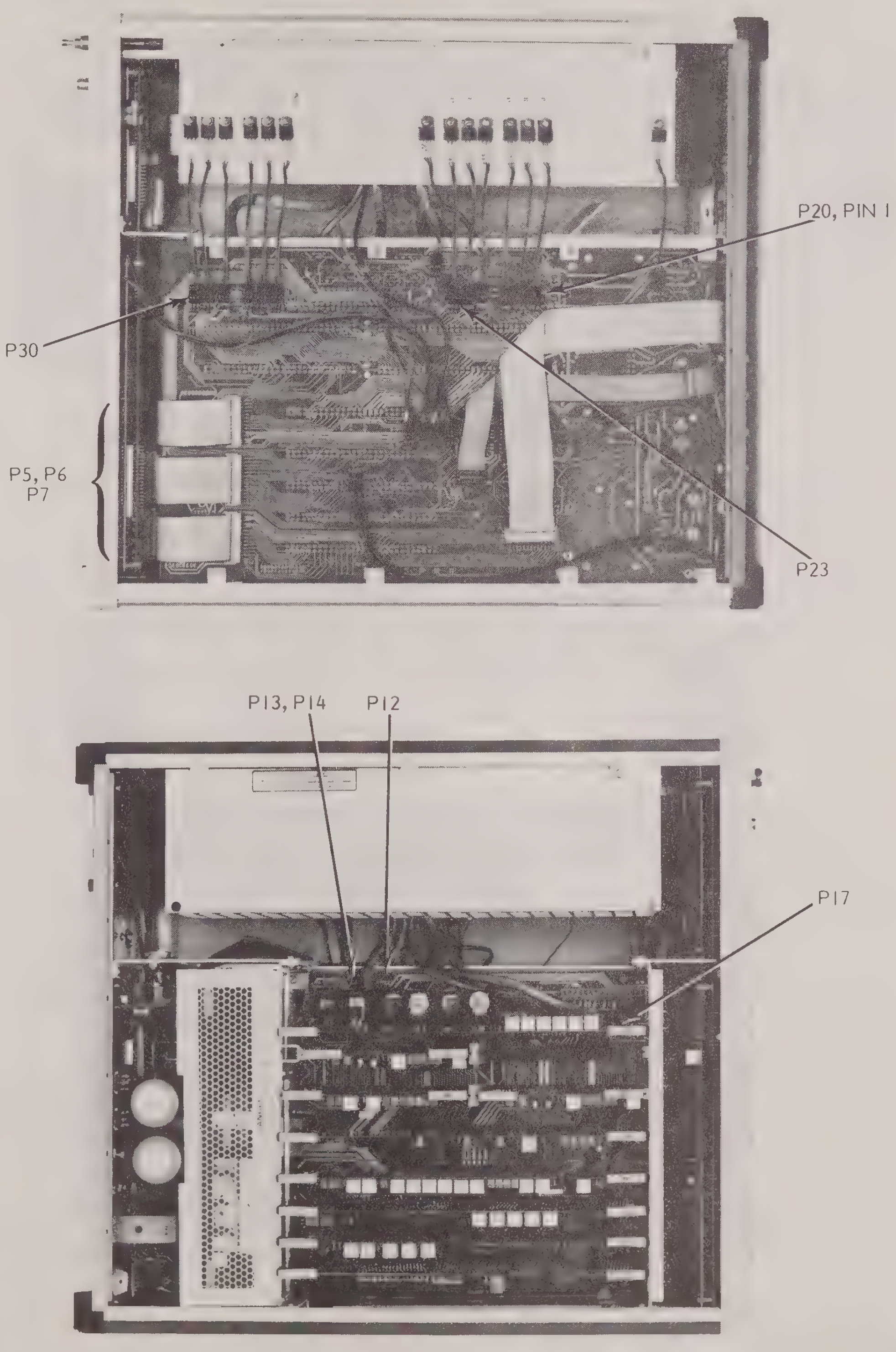

P20, PIN 1
P30
P5, P6
P7
P23
P13, P14
P12
P17

Figure 5-2. Connector Locations

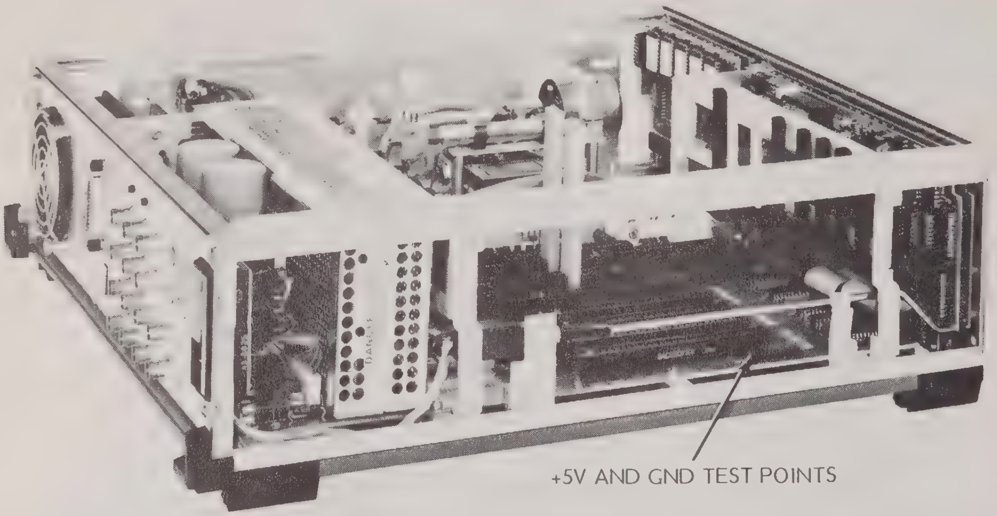

+5V AND GND TEST POINTS

Figure 5-3. Connector P3, Pins 13 and 26

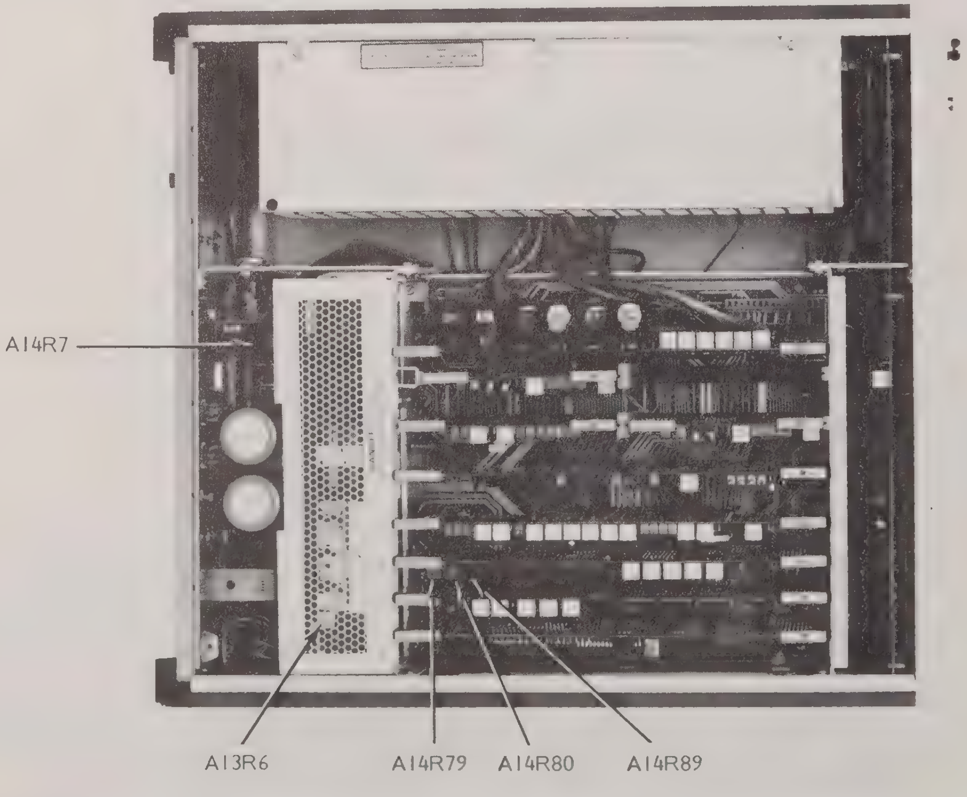

A14R7
A13R6
A14R79
A14R80
A14R89

Figure 5-4. A13/A14 Power Supply Adjustments

9. Connect the DMM test leads between the +5V and GND test points.

10. Press POWER to ON and adjust A13R6 (Figure 5-4) for +5V ± 1.0 mV.

b. -38 Volt Adjustment

1. Disconnect the DMM from P3 and connect it between A14P20, pin 1 (Figure 5-2), and chassis ground.

2. Adjust A14R7 (Figure 5-4) for -38V ± 100 mV.

3. Remove the DMM from P20.

c. Out-of-Regulation Adjustment

1. Adjust A14R89 clockwise to its limit.

2. While observing the A14 OUT OF REG indicator, readjust A14R89 counterclockwise until the indicator goes out. Stop.

3. While counting the number of potentiometer turns, continue to adjust A14R89 counterclockwise until the indicator lights. Stop.

4. Readjust A14R89 clockwise halfway between the indicator's on and off states.

d. Low Line Voltage Adjustment

1. Press POWER to OFF.

2. Connect test equipment as shown in Figure 5-1.

3. Adjust the variac for 100 Vac (12% below the nominal line voltage), as observed on the line voltage monitor.

4. Press Power to ON.

5. Adjust A14R79 (LOW) to its clockwise limit; then readjust counterclockwise until the A14 LOW LINE indicator lights.

6. Readjust the variac for 115 Vac (nominal line voltage), and ensure the LOW LINE indicator is not lit.

e. High Line Voltage Adjustment

1. Adjust the variac for 130 Vac (12% above the nominal line voltage).

2. Adjust A14R80 (HIGH) to its clockwise limit; then readjust counterclockwise until the HIGH LINE indicator lights.

3. Readjust the variac for 115 Vac (nominal line voltage), and ensure the HIGH LINE indicator is not lit.

f. Voltage Regulation and Ripple Checks

The A13/A14 power supplies are well regulated and filtered. Also, the low- and high-line monitoring circuits are adjusted to flag their respective error codes well in advance of specified limits. Consequently, the power supply regulation and filtering (ripple) need not be checked on a periodic schedule. However, in the event that regulation or filtering problems are suspected, the specifications in Table 5-2 are provided.

5-5 A2 RAMP GENERATOR ADJUSTMENTS

This paragraph provides instructions for adjusting the voltage and time of the A2 sweep ramp. These adjustments should be checked and, if necessary, adjusted following maintenance on the A2 PCB, and when any of the frequency specifications are found to be out of tolerance.

a. Reference Supply Verification

1. Connect test equipment as shown in Figure 5-5, and turn the equipment on.

2. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

3. With the digital multimeter (DMM) referenced to A2TP5 (Figure 5-6), monitor A2U18

   (a) pin 1 and verify the reference voltage is +12 ± 1.0 volts;

Table 5-2. Power Supply Regulation and Ripple Specifications

VOLTAGE SUPPLY	MONITOR POINT	REF. POINT	REGULATION TOLERANCE	RIPPLE TOLERANCE (pk-pk)
+5V	A14TP3	A14TP4	±3 mV	±50 mV
+15V LC	XA6-8	Chassis	±300 mV	±10 mV
-15V LC	XA6-9	Chassis	±300 mV	±10 mV
+15V HC	XA10-24	Chassis	±300 mV	±10 mV
-15V HC	XA10-23	Chassis	±300 mV	±10 mV
+24V	A14P12-2	Chassis	±300 mV	±10 mV
-38V	A14P20-1	Chassis	±300 mV	±10 mV

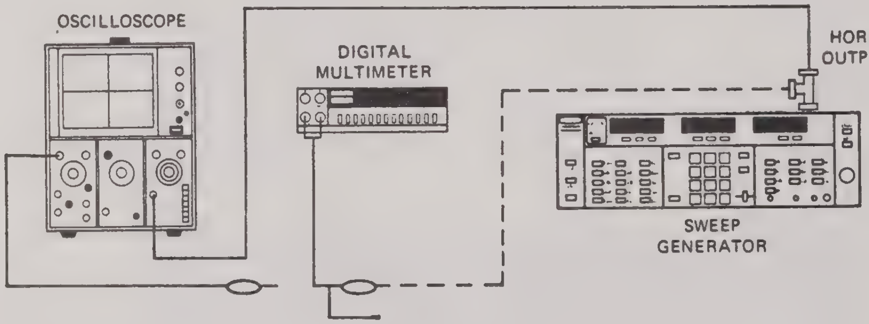


Figure 5-5. Test Equipment Setup for A2 Ramp Generator Adjustments

(b) pin 7 and verify the reference voltage is -12 ±1.0 volts.

b. Ramp Voltage Adjustment

1. Press RESET on sweeper.

2. On the oscilloscope, set the horizontal time base for External, and adjust its Vernier control so that the trace extends the full width of the screen (10 divisions).

3. On the sweeper, press SWEEP TIME and set for 99 seconds.

4. Connect the DMM common lead to A2TP5; connect the "hot" lead to A2TP6.

5. While the ramp is sweeping in the forward direction, adjust A2R31 for +10V ±1 mV.

6. Move the DMM hot lead to A2TP7

7. After the ramp has swept thru its first 10 seconds (1 division), adjust A2R39 for 0V ±1 mV.

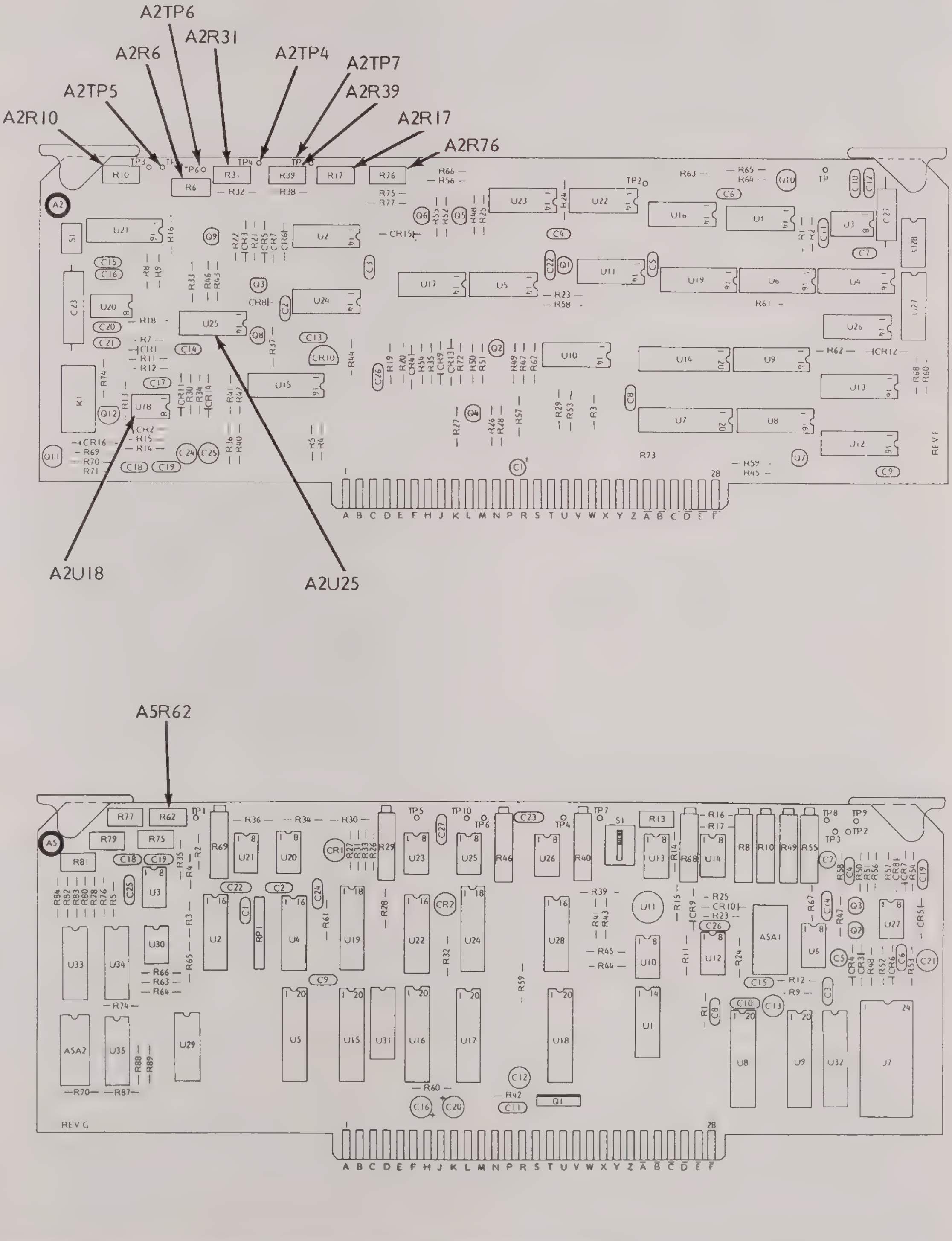

A2TP6
A2R31
A2R6
A2TP4
A2TP7
A2TP5
A2R39
A2R17
A2R10
A2R76
A2U18
A2U25
A5R62

Figure 5-6. A2 Ramp Generator Adjustments

8. Disconnect the DMM leads from the A2 PCB, and move them to the rear panel HORIZ OUTPUT connector (hot lead to the center conductor, and common lead to the shield).

9. Ground the center conductor on the rear panel EXT SWEEP connector.

10. Press SHIFT and EXTERNAL SWEEP (place the A2 PCB INT-EXT switch in EXT, for sweepers without the SHIFT functions).

11. Adjust A5R62 (Figure 5-6) for 0V ±1 mV.

12. Return the sweeper to AUTO sweep (INT-EXT switch back to INT) and remove the ground from the EXT SWEEP connector.

NOTE

The adjustment of A5R62 affects marker calibration. Check marker frequencies (paragraph 5-7) following the adjustment of A5R62.

c. Ramp-Voltage Clamping Adjustment

1. Disconnect the DMM leads from the HORIZ OUTPUT connector, and connect the test lead to A2TP4 and the common lead to A2TP5.

2. On the sweeper,
   (a) press SWEEP TIME and set for 50 ms;
   (b) press EXT OR SINGLE twice (trigger a single sweep);
   (c) adjust A2R76 for +10V ±1 mV. (Allow 15-30 seconds for the voltage to settle, before taking a voltage reading.)

3. Disconnect the DMM leads from A2TP4 and A2TP5.

d. Sweep Time Adjustment

1. Connect the oscilloscope as follows:
   (a) probe to A2TP4,
   (b) ground to A2TP5.

2. Set the oscilloscope controls as follows:
   (a) vertical to 2V per division,
   (b) horizontal to 200 ms per division.

3. On the sweeper,
   (a) press ΔF F0;
   (b) press SWEEP TIME and set for 0.999 seconds;
   (c) adjust A2R10 for a forward sweep duration (Figure 5-7) of 1.0 ±0.1 seconds.

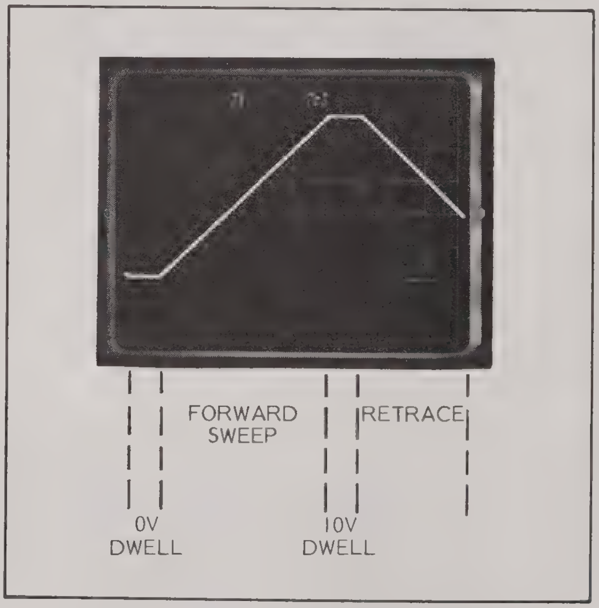


Figure 5-7. A2 Sweep Ramp

4. Set the oscilloscope horizontal for 2 ms per division.

5. On the sweeper,
   (a) set SWEEP TIME for 10 ms;
   (b) adjust A2R6 for a forward sweep duration of 10 ±1 ms.

6. Set the oscilloscope horizontal control for 200 ms per division.

7. On the sweeper,
   (a) set SWEEP TIME for 1 second;
   (b) adjust A2R17 for a forward sweep duration of 1.0 ±0.1 second.

8. With the oscilloscope, verify retrace and dwell times at 10 ms and 1 second. Retrace and dwell time specifications are shown in Table 5-3. If the retrace time is out of tolerance, check that +15V is present at A2R8 (Figure 7-33, Sheet 2). If +15V is present, troubleshoot A2U21D and associated resistors. If the dwell time is out of tolerance, troubleshoot the dwell timing circuit (paragraph 7-9.1b).

Table 5-3. Retrace and Dwell Time Specifications

SWEEP TIME	RETRACE TIME	DWELL TIME
10 ms to 0.999 s	10 ±1 ms	5 ±0.2 ms
1 s to 99 s	1 ±0.1 s	5 ±0.2 ms*

*At zero-volt dwell, dwell time is proportional to sweep time.

5-6 A5 FREQUENCY INSTRUCTION ADJUSTMENTS

This paragraph provides instructions for adjusting the A5 sweep width (ΔF) ramp, the A5 F Center DAC voltages, and the A6-A9 bandswitch reference voltages. These adjustments should be checked and, if necessary, adjusted following maintenance on any of the A5-A9 PCBs or when any of the frequency specifications are found to be out of tolerance.

a. Bandswitch Reference Voltage Adjustment

1. Set up the test equipment as shown in Figure 5-8 and turn the equipment on.

2. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

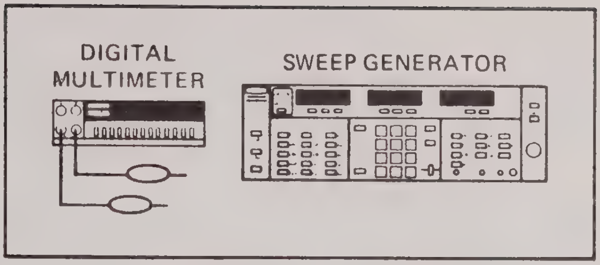


Figure 5-8. Setup for A5 Frequency Instruction Adjustments

3. Connect the common lead on the digital multimeter (DMM) to A5TP3 (Figure 5-9) and the test lead to A5TP9.

4. Adjust A5R55 for +10V ± 1.0 mV.

5. Move the DMM test lead to A5TP8 and adjust A5R49 for -10 ± 1.0 mV.

b. Sweep Width (ΔF) Signal Path Adjustments

1. Press RESET.

2. Press SHIFT, then EXT SWEEP.

3. Remove the DMM leads from A5TP8 and A5TP3. Connect a BNC-to-clip-lead jumper between the rear panel EXT SWEEP connector and A5TP9 and A5TP3 (center conductor to A5TP9).

4. Connect the DMM test lead to A5TP5 and the common lead to A5TP10. Note the voltage level at A5TP5.

5. Disconnect the BNC connector from EXT SWEEP; note the voltage value at A5TP5.

6. Alternately connect and disconnect the BNC connector at the EXT SWEEP connector, and adjust A5R29 for equal TP5 voltages, ±1.0 mV. Record this voltage value.

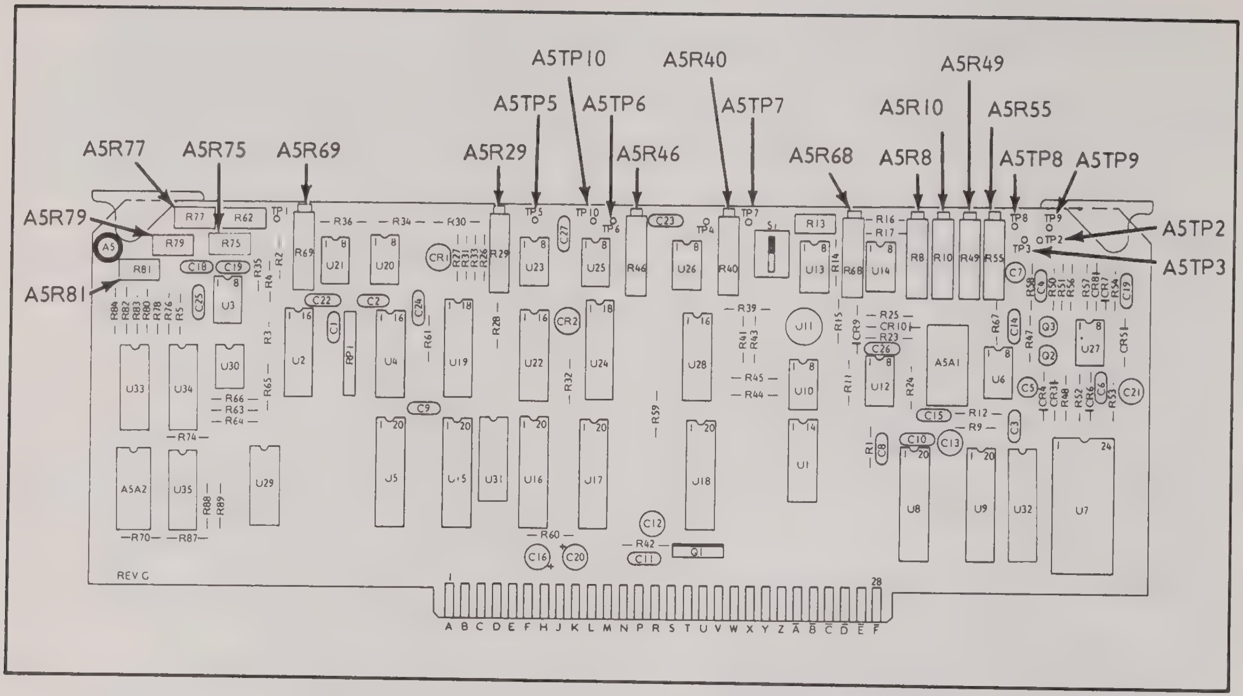

A5TP10
A5R40
A5R49
A5TP5
A5TP6
A5TP7
A5R10
A5R55
A5R77
A5R75
A5R69
A5R29
A5R46
A5R68
A5R8
A5TP8
A5TP9
A5R79
A5TP2
A5TP3
A5R81
REV C

Figure 5-9. A5 Frequency Instruction Adjustments

7. Press MANUAL SWEEP, and rotate its associated control fully clockwise.

8. Adjust A5R69 for the voltage value recorded in step 6 above.

9. Rotate the MANUAL SWEEP control fully counterclockwise, and verify that the voltage at A5TP5 is the same as that recorded in step 10 above, ±25.0 mV.

10. Rotate the MANUAL SWEEP control to midrange (0 volts at A5TP5).

11. Press ΔF F0.

12. Press ΔF and set for 0 MHz.

13. Move the DMM test lead to A5TP6.

14. Adjust A5R46 for 0V ±1.0 mV.

15. Move the DMM test lead to A5TP7.

16. Adjust A5R40 for 0V ±1.0 mV.

c. F Center Adjustments

1. Press TRIGGER AUTO.

2. Press CW F1 and verify it is set for the low-end frequency.

3. Move the DMM test lead to A5TP2 and the common lead to A5TP3.

4. Adjust A5R10 for the applicable voltage shown below, ±1 mV:

Model	Voltage (mVdc)
6609A	50.0
6617A	12.5
6621A, 6621A-40	1,612.9
6629A, 6629A-40	4,301.0
6637A, 6637A-40	1,075.2
6638A	1,000.0
6642A	4,500.0
6647A	5.4
6648A	5.0
6653A	754.7
6659A	3.8

5. Press CW F2 and set for the high-end frequency.

6. Adjust A5R8 for 10V ±0.1 mV.

7. Using CW F1 and CW F2, repeat (if necessary) the low- and high-end frequency adjustments until the voltages specified above are achieved.

d. Frequency-Band Overlap Adjustments (Not for 6609A or 6642A)

1. Connect equipment as shown in Figure 5-10, and turn the equipment on.

2. Het Band Overlap Adjustment (Models 6617A, 6647A, 6648A, and 6659A)

    (a) On the sweeper,

        (1) press RESET;
        (2) press ΔF F0;
        (3) press ΔF and set for 250 MHz;
        (4) press F0 and set for 2 GHz;
        (5) press SWEEP TIME and set for 20 seconds.

    (b) On the spectrum analyzer,

        (1) press FREQUENCY RANGE GHz as appropriate to display the F0 frequency;
        (2) adjust TUNING for the frequency that was set in step 2 (a)(4) above;
        (3) position INPUT ATTEN so that the top of the swept-frequency display is visible (Figure 5-11);
        (4) adjust INTENSITY and PERSIST so that the overlap width shows up as an intensification of the swept display (Figure 5-11).

    (c) On the sweeper, adjust A5R81 for a frequency overlap of 5 MHz.

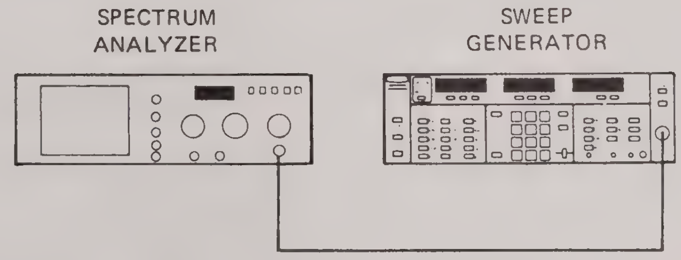
3. Osc 1 Overlap Adjustment (Models 6621A, 6621A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, and 6659A)

    (a) For 6647A, 6648A, and 6659A: press F0 and set for 8 GHz.

    (b) For all other models: perform step 2(a), (1) thru (4), but set F0 for 8 GHz.

    (c) Perform step 2(b), (1) thru (4).

    (d) On sweeper, adjust A5R79 for a frequency overlap of 5 MHz.



Spectrum Analyzer Control Settings

FREQUENCY BAND GHz: See procedure
INPUT ATTEN: See procedure
REFERENCE LEVEL: -20 dBm
AMPLITUDE SCALE: 10 dB
FREQUENCY SPAN/DIV: 5 MHz
RESOLUTION BW: 100 kHz (Coupled)
FREQUENCY SPAN MODE: PER DIV

SWEEP TIME/DIV: AUTO
SWEEP TRIGGER: FREE RUN
SWEEP SOURCE: INT
VIDEO FILTER: Off
WRITE: On (In)
BASE LINE CLIPPER: OFF
AUTO STABILIZER: On (out)
TUNING: See procedure

Figure 5-10. Test Equipment Setup For Frequency-Band Overlap Test

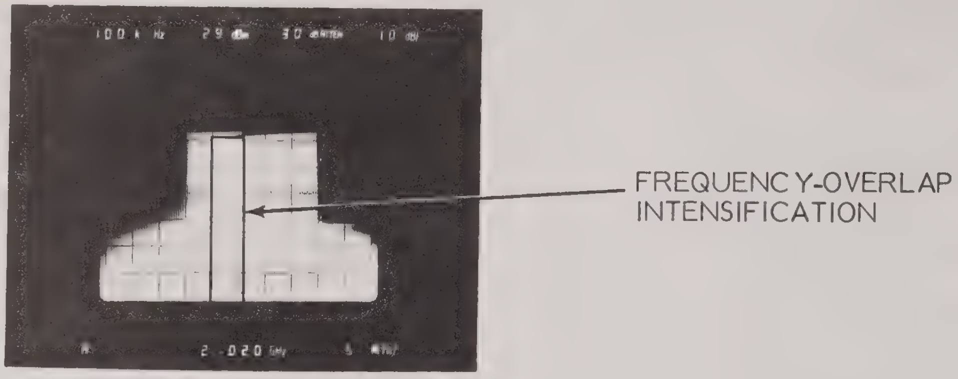


Figure 5-11. Swept-Frequency Display, Showing Frequency Overlap

4. Osc 2 Overlap Adjustment (Models 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, and 6659A)

   (a) For 6629A and 6629A-40: perform steps 2(a), (1) thru (4), but set F0 for 12.4 GHz.

   (b) For all other models: press F0 and set for 12.4 GHz.

   (c) Perform steps 2(b), (1) thru (4).

   (d) On the sweeper, adjust A5R77 for a frequency overlap of 5 MHz.

5. Osc 3 Overlap Adjustment (Models 6653A and 6659A)

   (a) Press F0 and set for 18 GHz.

   (b) Perform steps 2(b), (1) thru (4).

   (c) On the sweeper, adjust A5R75 for a frequency overlap of 5 MHz.

e. V/GHz Adjustment

1. Press F1 and set for the high-end frequency.

2. Connect the DMM leads to the rear panel 1V/GHz connector.

3. Adjust A5R68 for a voltage value equal to 1V per GHz, ±2.0 mV, of F1 frequency (0.5V/GHz for the 6642A, 6653A, and 6659A). Example: If the high-end frequency is 2 GHz (6609A), adjust A5R68 for 2.0 volts, ±2.0 mV. If the high-end voltage is 18.6 GHz (6647A), adjust A5R68 for 18.6 volts, ±2.0 mV. And if the high-end frequency is 26.5 GHz (6653A), adjust A5R68 for 13.25 volts, ±2.0 mV.

4. Press F1 and set for the low-end frequency.

5. Verify that the DMM reads a voltage value equal to 1V/GHz, ±25.0 mV, of F1 frequency.

5-7 A3 MARKER GENERATOR ADJUSTMENTS

This paragraph provides instructions for adjusting both the F0, M1, and M2 marker frequencies and the MODIFY SIGNAL output voltage from the front panel INCREASE/DECREASE lever. These adjustments should be checked and, if necessary, adjusted following maintenance on the A3 PCB.

Two methods for adjusting the marker frequencies are provided: (1) using the Model 560 or 560A Scalar Network Analyzer and (2) using an oscilloscope. The method using the 560 or 560A (subparagraph c) is preferred. If a 560 or 560A is not available, an alternate procedure using an oscilloscope is described in subparagraph b.

The reference voltage check in subparagraph a. below should be performed before adjusting the marker frequencies.

a. A3 Reference Voltage Check

1. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions.
2. Press POWER to ON.
3. Press RESET.
4. With a digital multimeter (DMM) referenced to A3TP1 (Figure 5-13),
   (a) monitor A3U3 pin 1 (R33 lead nearest top edge of PCB); verify voltage is -10 ±0.25V.
   (b) monitor A3U3 pin 7 (middle terminal on R13); verify the voltage is -10 ±0.25V.
5. If either voltage is out of tolerance, troubleshoot A3U3 and its associated components before continuing with this procedure.

b. Marker Frequency Calibration Using an Oscilloscope

1. Set up the test equipment as shown in Figure 5-12, and turn the equipment on.
2. Connect the DMM "hot" lead to the center conductor of the rear panel HORIZ OUTPUT connector; connect the common lead to the shield.
3. Ground the center conductor on the rear panel EXT SWEEP connector.
4. Press SHIFT and EXT SWEEP (place the A2 PCB INT/EXT switch in EXT, for sweepers without the SHIFT functions).
5. Adjust A5R62 (Figure 5-12) for 0V ±1 mV.
6. Return the sweeper to AUTO sweep (INT/EXT switch back to INT) and remove the ground from the EXT SWEEP connector.
7. Disconnect the DMM from the HORIZ OUTPUT connector.
8. On the sweeper,
   (a) press MARKERS VIDEO;
   (b) rotate MARKER AMPLITUDE fully clockwise;
   (c) press F0 and set for the high-end frequency;

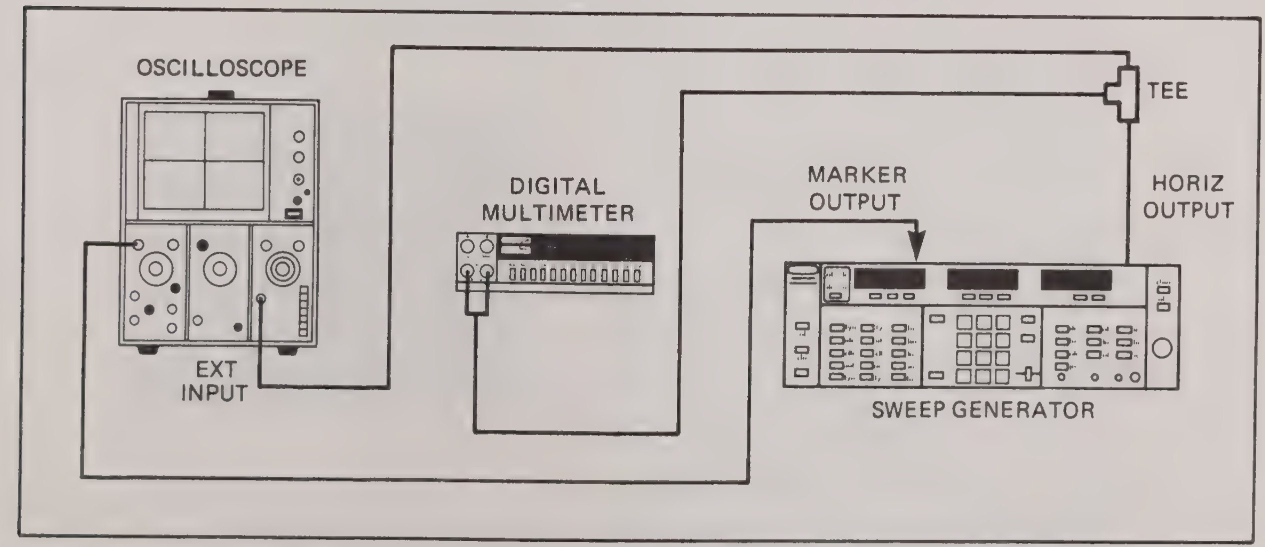


Figure 5-12. Test Equipment Setup for A3 Marker Generator Adjustments

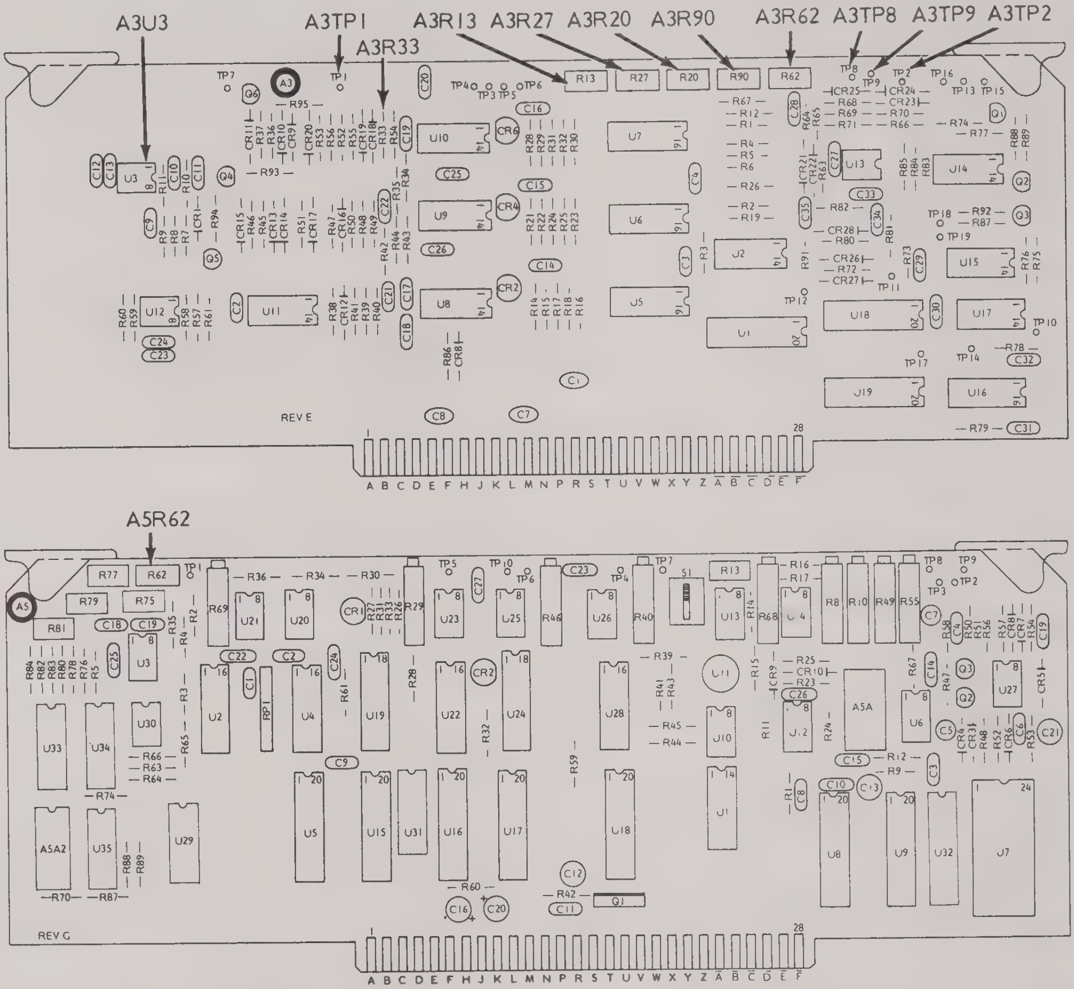

A3U3
A3TP1
A3R33
A3R13
A3R27
A3R20
A3R90
A3R62
A3TP8
A3TP9
A3TP2
A5R62
REV E
REV G
A3
A5

Figure 5-13. A3 Marker Generator Adjustments

(d) adjust A3R13 (Figure 5-13) until the F0 marker is just visible on the right edge of the oscilloscope display, as shown in Figure 5-14;

(e) set F0 for 10 GHz;

(f) press M1 and set for the high-end frequency;

(g) using A3R20, repeat step (d) above for the M1 marker;

(h) set M1 for 12 GHz;

(i) press M2 and set for high-end frequency;

(j) using A3R27, repeat step (d) above for the M2 marker.

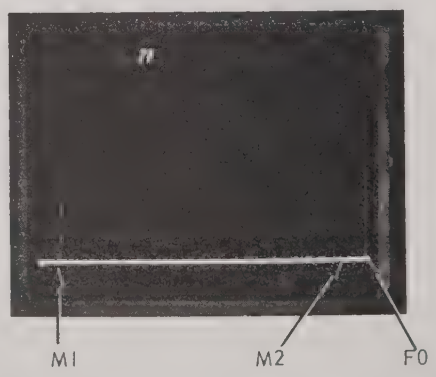
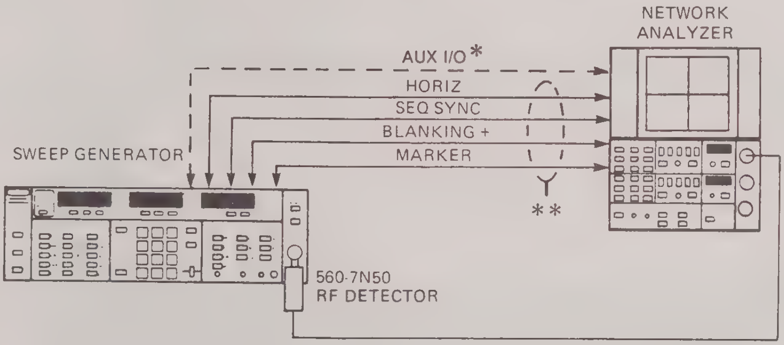


Figure 5-14. F0, M1, and M2 Markers

c. Marker Frequency Calibration Using the Model 560 or 560A Scalar Network Analyzer

1. Set up the test equipment as shown in Figure 5-15, and turn the equipment on.
2. On the sweeper,
   (a) press RESET;
   (b) press SHIFT, then CW RAMP;
   (c) press MARKERS VIDEO;
   (d) rotate MARKERS AMPLITUDE fully clockwise.
3. On the network analyzer,
   (a) adjust Channel A OFFSET to position the trace in the center of the display;
   (b) adjust MARKERS THRESHOLD, if necessary, to obtain markers.
4. On the sweeper,
   (a) press F0 and set for high-end frequency;
   (b) adjust A3R13 (Figure 5-13) until the F0 marker is just visible on the right edge of the 560 display, as shown in Figure 5-16.
   (c) set F0 for 10 GHz;
   (d) press M1 and set for high-end frequency;
   (e) using A3R20, repeat step (b) above for the M1 marker;



Initial Control Settings

Sweep Generator

MARKER AMPLITUDE: Fully CW
HORIZ OUTPUT DURING CW (rear panel): ON
SLOPE: OFF

Scalar Network Analyzer

CHANNEL A ON: On
INPUT: A
MEMORY: Off
dB PER DIVISION: 5
REFERENCE dB/dBm: dBm
SET (screwdriver pot): Midrange
OFFSET: +10
CHANNEL B: Not used
MARKER THRESHOLD: Midrange
REAL TIME: On
SMOOTHING: Off
POWER: On

*Used with 560A. Also set:
HORIZONTAL SELECT: 10V
Z-AXIS SEL: EXT

**560 only.

Figure 5-15. Test Setup for Marker Frequency Adjustment, Using the Model 560 or 560A Scalar Network Analyzer

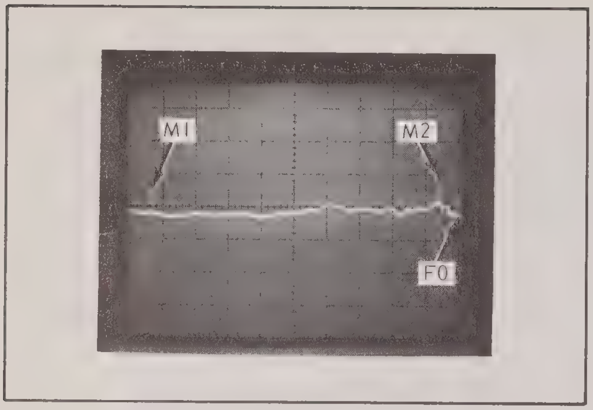


Figure 5-16. Model 6637A Markers, as shown on 560 Display

(f) set M1 for 12 GHz;

(g) press M2 and set for high-end frequency;

(h) using A3R27, repeat step (b) above for the M2 marker.

d. INCREASE/DECREASE Lever Voltage Adjustment

1. Connect the common lead on the DMM to A3TP2, and the test lead to A3TP8.

2. Move the INCREASE/DECREASE lever to full INCREASE; release the lever and allow it to spring back to the center. Note the voltage value.

3. Move the INCREASE/DECREASE lever to full DECREASE; release the lever and allow it to spring back to the center. Note the voltage value.

4. Repeat steps 2 and 3, and adjust A12R46 (Figure 5-17) until the noted

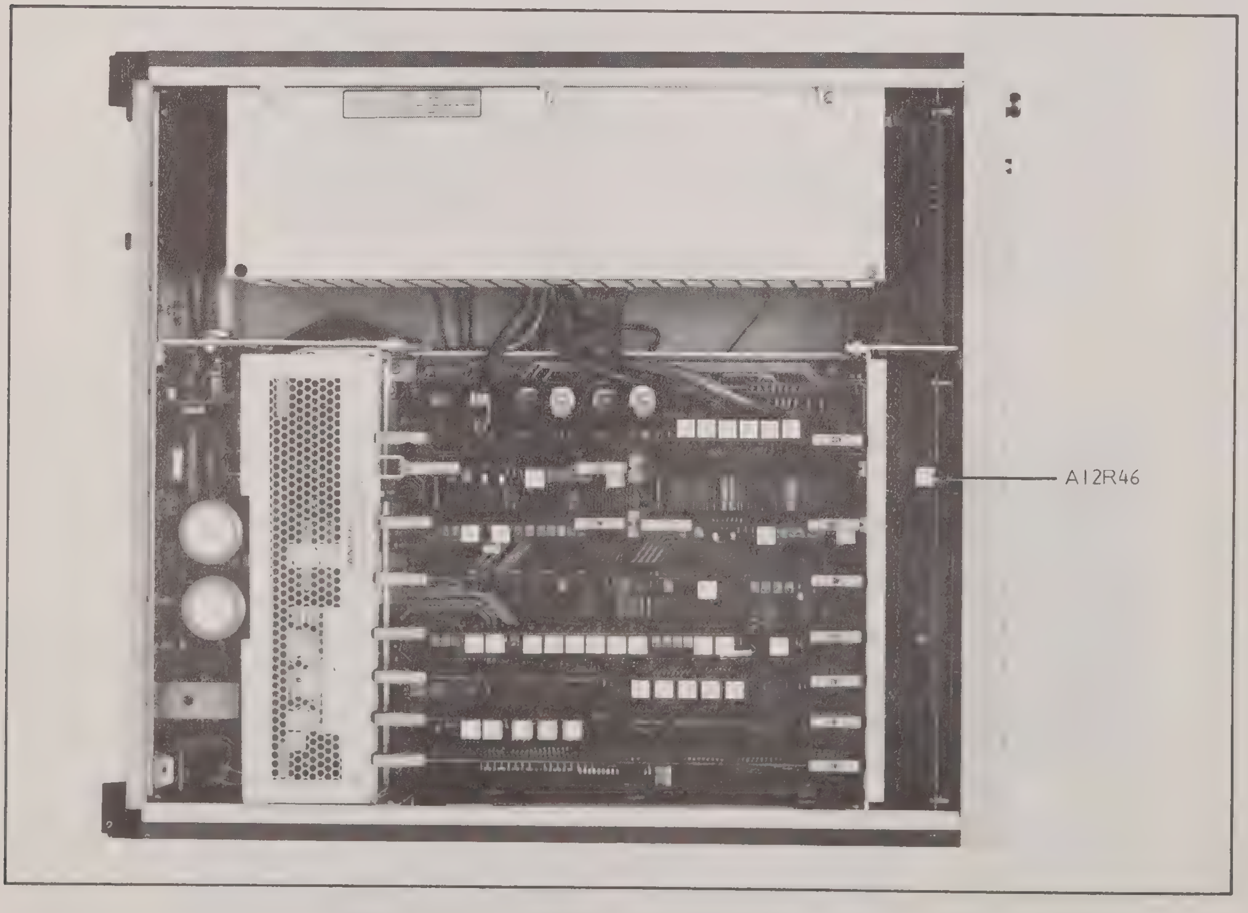


Figure 5-17. A12R46 Adjustment Location

voltages are equal, ±200 mV. Voltage value should be between 0 and ±0.5V.

5. Transfer the DMM test lead to A3TP9.

6. Move the INCREASE/DECREASE lever to its full INCREASE position, and adjust A3R62 (Figure 5-13) for +4.8V ± 20 mV.

7. Move the INCREASE/DECREASE lever to its full DECREASE position, and adjust A3R90 for +4.8V ± 20 mV.

5-8 A6-A9 YIG (HET/YIG) DRIVER PCB ADJUSTMENTS

Procedures for adjusting the A6-A9 YIG (Het/YIG) Driver PCBs are provided in paragraphs 5-8.1 and 5-8.2. Depending upon model, the 6600A Series sweep generators have from 1 to 4 YIG Driver PCBs installed. There are two field-level adjustments on each YIG Driver PCB: YIG bias and oscillator-bandswitching voltage. The bandswitching-voltage adjustments, plus an adjustment on the A5 PCB that must be performed at the highest bandswitch point for each model, are described in paragraph 5-8.1. The YIG bias adjustments are described in paragraph 5-8.2.

5-8.1 A6-A9 Oscillator-Bandswitching Voltage Adjustments

This paragraph provides instructions for adjusting the A6-A9 PCB oscillator-bandswitching voltages. These adjustments should be performed following maintenance on the A6-A9 PCBs. A guide directing which steps need to be performed for which model numbers is provided in Table 5-4.

Table 5-4. Model Number Guide to A6-A9 PCB Bandswitching-Voltage Adjustments in Paragraph 5-8.1

MODEL	PERFORM SUBPARAGRAPH(S)
6609A	------
6617A	a., b., c., g.
6621A & 6621A-40	a., b., d., g.
6629A & 6629A-40	a., b., e., g.
6637A & 6637A-40	a., b., d., e., g.
6638A	a., b., d., e., g.
6642A	a., b., d., g.
6647A	a., b., c., d., e., g.
6648A	a., b., c., d., e., g.
6653A	a., b., d., e., f., g.
6659A	a., b., c., d., e., f., g.

a. Set up the test equipment as shown in Figure 5-18, and turn the equipment on.

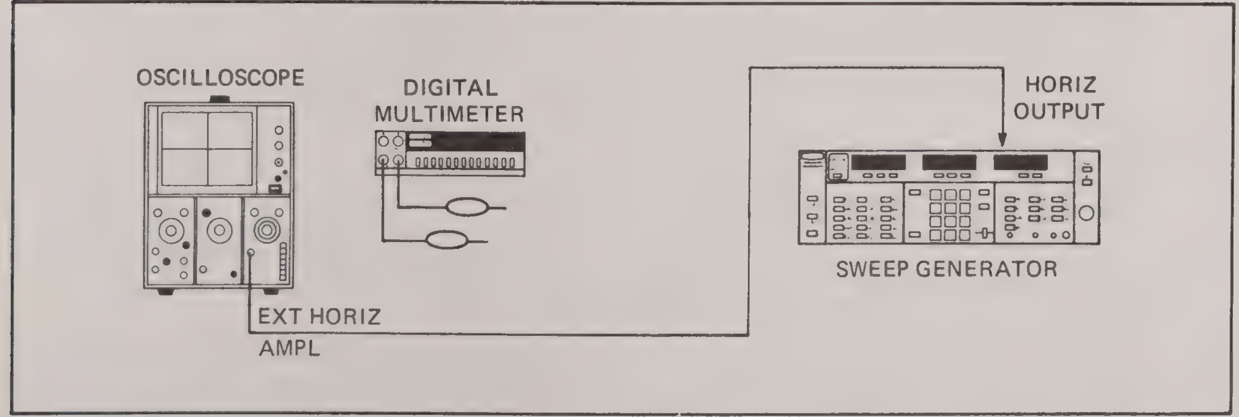


Figure 5-18. Test Equipment Setup for the A6-A9 YIG Driver Adjustments

b. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

c. A6 PCB, 2 GHz Bandswitching-Voltage Adjustment.

1. Press RESET on sweeper.
2. Press CW F1 and set for 2 GHz.
3. Connect the DMM test lead to A6TP5; connect the common lead to A6TP1 (Figure 5-19).
4. Adjust A6R65 clockwise until the DMM reads ≈ 0V (TTL low).
5. Readjust A6R65 counterclockwise until the DMM reads ≈+5V (TTL high).
6. For the 6617A, rotate the 8 GHz bandswitching adjustment (R58) fully clockwise.

d. A6 PCB 8 GHz (or 26.5 GHz for Model 6642A) Bandswitching-Voltage Adjustment

1. Press CW F1 and set for 8 (or 26.5) GHz.
2. Move the DMM test lead to A6TP4.
3. Adjust A6R58 clockwise until the DMM reads ≈0V (TTL low).
4. Readjust A6R58 counterclockwise until the DMM reads ≈+5V (TTL high).
5. For the 6621A, 6621A-40, and 6642A, rotate the A7 PCB bandswitching adjustment (A7R68) fully clockwise.

e. A7 PCB Bandswitching-Voltage Adjustment

1. Press CW F1 and set for 12.4 GHz.
2. Connect the DMM test lead to A7TP4 (Figure 5-20); connect the common lead to A7TP1.
3. Adjust A7R68 counterclockwise until the DMM reads ≈ 0V (TTL low).
4. Readjust A6R58 counterclockwise until the DMM reads ≈+5V (TTL high).
5. For the 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, and 6648A, rotate the A8 PCB bandswitching adjustment (A8R68) fully clockwise.

f. A8 PCB Bandswitching-Voltage Adjustment (6653A/6659A)

1. Press CW F1 and set for 18 GHz.
2. Connect the DMM test lead to A8TP4 (Figure 5-20); connect the common lead to A8TP1.
3. Adjust A8R68 counterclockwise until the DMM reads ≈0V (TTL low).
4. Readjust A8R68 clockwise until the DMM reads ≈+5V (TTL high).

g. A5 Volts-Per-Frequency Adjustment

1. Press FREQUENCY RANGE ΔF F0.
2. Press F0 and set for the frequency shown below:

Model	Frequency (GHz)
6617A	2.000
6621A & 6621A-40	8.000
6642A	26.500
6653A & 6659A	18.000
All Others	12.400

3. Adjust the oscilloscope vertical controls to obtain a horizontal trace, as shown in Figure 5-21.
4. Adjust A5R13 on the Frequency Instruction PCB to center the bandswitch intensity-dot on the oscilloscope display (Figure 5-21).

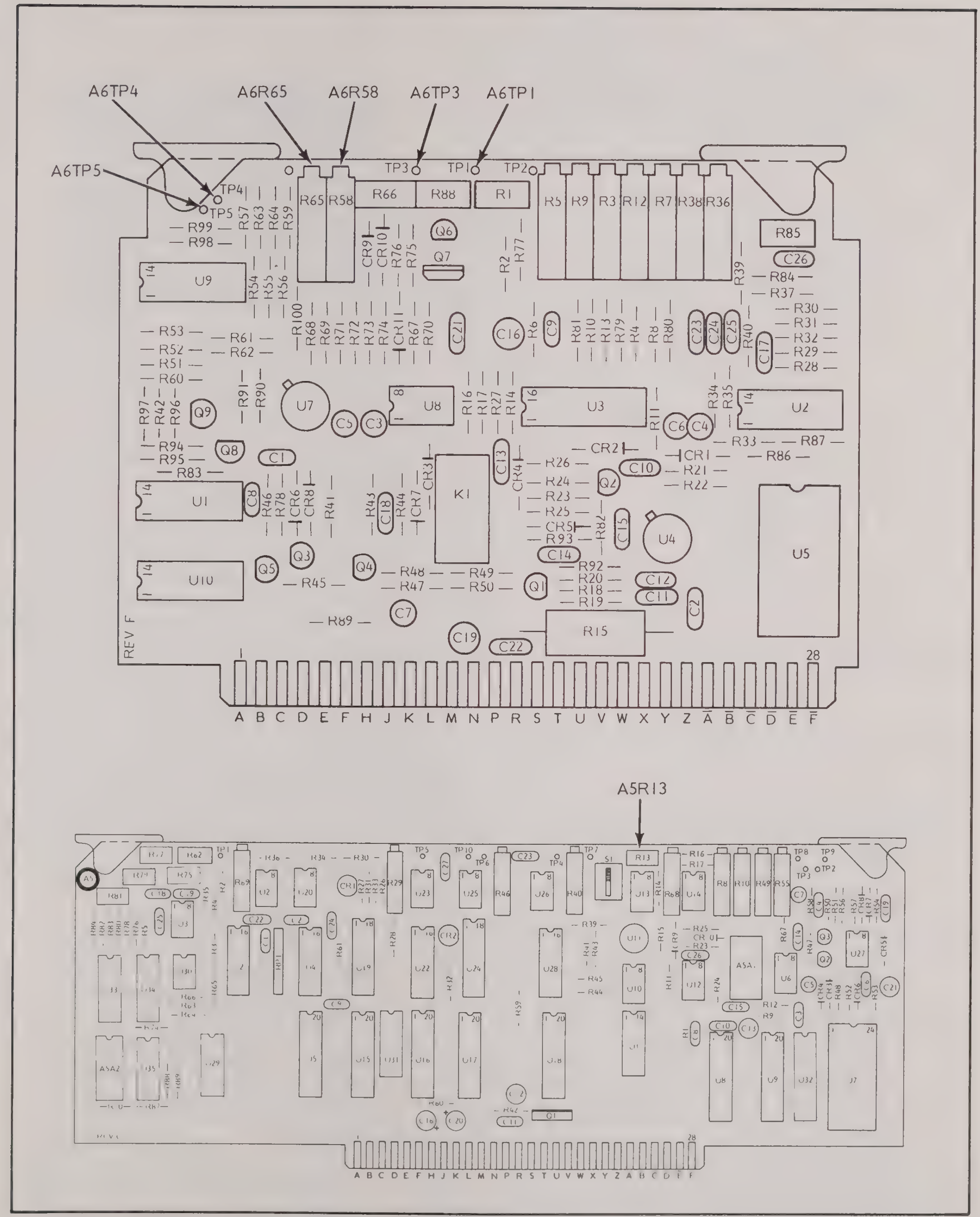

A6TP4
A6R65
A6R58
A6TP3
A6TP1
A6TP5
A5R13

Figure 5-19. A6 YIG Driver Adjustments

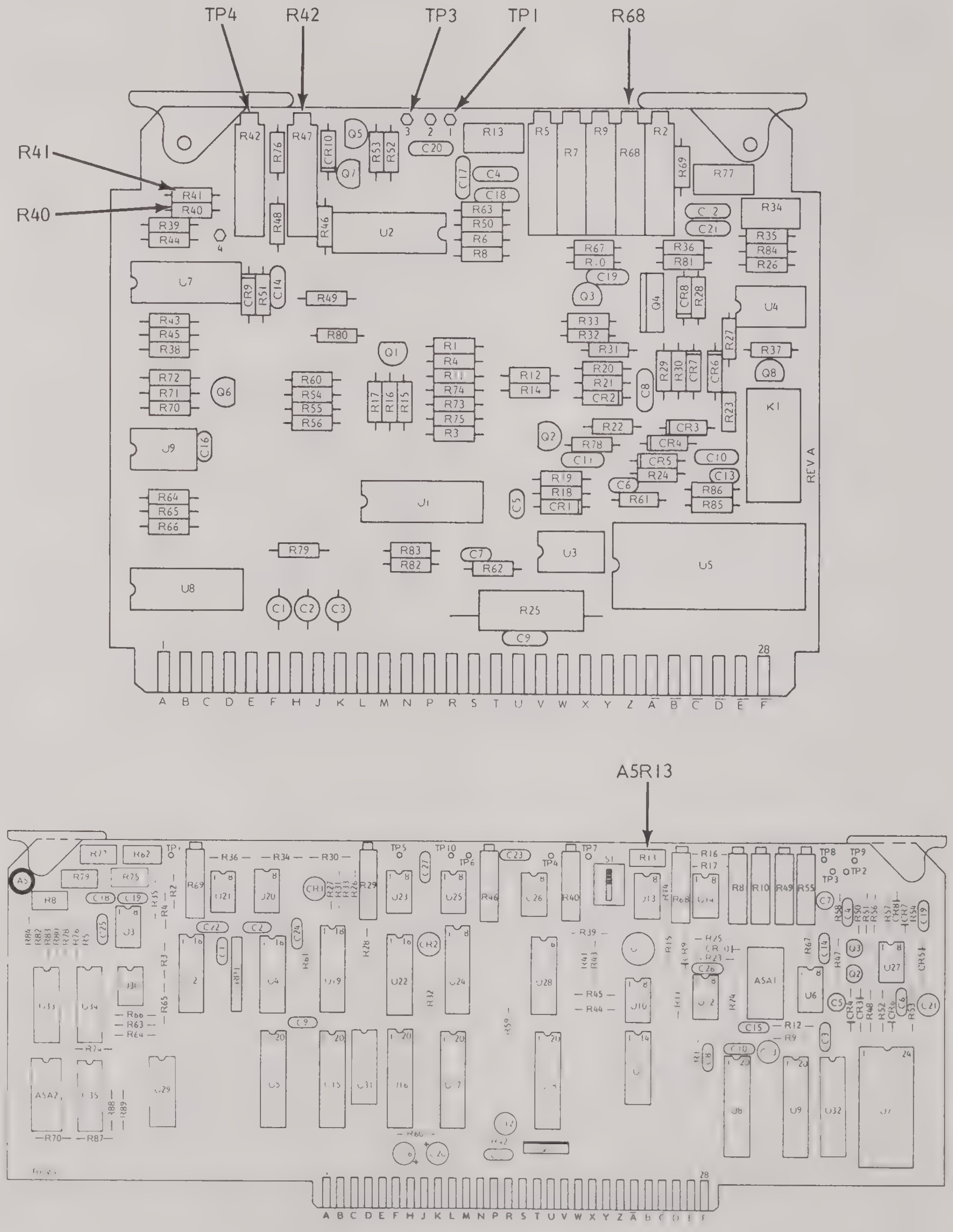

TP4
R42
TP3
TP1
R68
R41
R40
A5R13

Figure 5-20. A7-A9 YIG Driver Adjustments

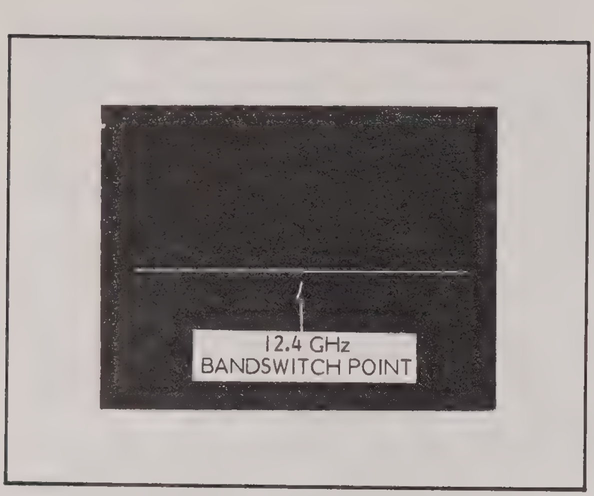


Figure 5-21. Bandswitch Dwell Signal

5-8.2 YIG Bias Check

This paragraph provides instructions for checking YIG oscillator bias voltage(s). YIG-oscillator bias is a factory adjustment that is not normally required except when a YIG oscillator has been replaced or maintenance has been performed in the A6-A9 PCB bias circuit. When a YIG oscillator is replaced, however, no bias adjustment is required by the user because WILTRON supplies a fully calibrated replacement YIG and YIG driver PCB. (The YIG driver PCB must be replaced with the YIG oscillator, because of the uniquely programmed linearizer ROM.) After maintenance in the bias circuit or during troubleshooting, check and adjust YIG bias as follows:

CAUTION

> When a replacement YIG has been installed or maintenance has been performed in the A6-A9 PCB YIG bias circuitry, check that the RF Deck-mounted bias-output transistor Q3 is not short-circuited BEFORE APPLYING POWER TO THE YIG.

a. Set up the equipment as shown in Figure 5-22, and turn the equipment on.

b. Remove the top cover from the sweep generator; refer to paragraph 7-3.1, if necessary.

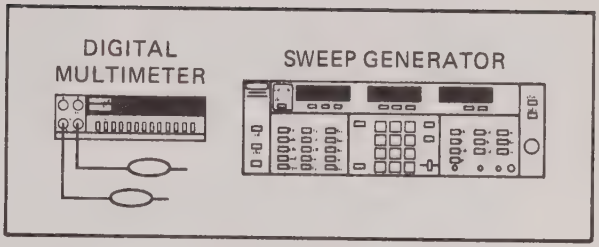


Figure 5-22. Test Equipment Setup for A8 YIG Driver Bias Adjustments

c. A6 PCB YIG Bias Check

1. For all models except 6629A, 6629A-40 and 6642A:
    - (a) Connect the digital multimeter (DMM) test lead to A6TP3 (Figure 5-19); connect the common lead to A6TP1.
    - (b) Verify that the DMM reads -5 ±0.2 Vdc.
2. For the 6629A, 6629A-40, and 6642A: Perform the steps in subparagraph d. below.

d. A7-A9 PCB YIG Bias Check and Adjustment

1. Look in the upper-left quadrant of the applicable A7-A9 PCB and determine whether resistors R40 and R41 are installed (Figure 5-20).
    - (a) If the resistors are installed, the YIG uses a sweeping-bias voltage. Proceed to step 2.
    - (b) If the resistors are not installed, the YIG uses a fixed-bias voltage. Proceed to step 3.
2. Sweeping-Bias Voltage Check and Adjustment Procedure
    - (a) Remove the cover from the RF Deck Assembly, and read the bias voltage stamped on the applicable YIG oscillator. Typically, the bias-voltage annotation

will read as follows: "BIAS -12.0V -9.0V." The first value is the low-end voltage; the second value is the high-end voltage. These are nominal voltage values.

(b) Connect the digital multimeter (DMM) test lead to TP3 (Figure 5-20); connect the common lead to TP1.

(c) Press RESET.

(d) Press FREQUENCY RANGE F1-F2.

(e) Press F1 and set for the applicable YIG's low-end voltage (Table 5-5).

(f) Press F2 and set for the applicable YIG's high-end voltage.

(g) Press MANUAL SWEEP and rotate its associated control fully counterclockwise.

(h) If maintenance has been performed on the bias circuit and the voltage is being adjusted, refer to step (1); otherwise, refer to step (2).

(1) Adjust R47 for the low-end bias voltage stamped on the YIG.

(2) Check that the bias voltage is approximately equal to the bias voltage value stamped on the YIG.

(i) Rotate the MANUAL SWEEP control fully clockwise.

(j) If maintenance has been performed on the bias circuit and the voltage is being adjusted, refer to step (1); otherwise, refer to step (2).

(1) Adjust R42 for the high-end bias voltage stamped on the YIG.

(2) Check that the bias voltage is approximately equal to the bias-voltage value stamped on the YIG.

Table 5-5. Oscillator Frequencies

OSCILLATOR BAND	MODEL(S)	FREQUENCY (GHz)	
		LOW END	HIGH END
1	6617A, 6621A, 6621A-40, 6637A, 6637A-40, 6638A, 6647A, 6653A, 6659A	2.000	8.000
1	6642A	18.000	26.500
2	6621A, 6621A-40, 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A	8.000	12.400
2	6642A	26.500	40.000
3	6629A, 6629A-40, 6637A 6637A-40, 6638A, 6647A 6648A	12.400	18.600
3	6653A, 6659A	12.400	18.000
4	6653A, 6659A	18.000	26.500

age is approximately equal to the bias-voltage value stamped on the YIG.

3. Fixed-Bias Voltage Check and Adjustment Procedure

   (a) Press POWER to OFF.

   (b) Remove the A7 PCB and note whether its assembly number is 660-D-8008 or -8009 (-8190 or -8191 respectively for the 6642A). This information will be used in steps (f) and (g).

   (c) Reinstall the PCB, and press POWER to ON.

   (d) Connect the test lead of the digital multimeter (DMM) to TP3; connect the common lead to TP1.

   (e) Press RESET.

   (f) PCB assembly 660-D-8008 (8190): If maintenance has been performed in the bias circuit and the voltage is being adjusted, refer to step (1); otherwise, refer to step (2).

      (1) Adjust R47 for -5 Vdc.

      (2) Check that the bias voltage is approximately -5 Vdc.

   (g) PCB Assembly 660-D-8009 (-8191): If maintenance has been performed in the bias circuit and the voltage is being adjusted, refer to step (1); otherwise, refer to step (2).

      (1) Adjust R47 for +15 Vdc.

      (2) Check that the bias voltage is approximately +15 Vdc.

5-9 FREQUENCY CALIBRATION

This paragraph provides instructions for calibrating the sweep generator's frequency. Frequency calibration procedures are provided for each Osc 1 thru Osc 4 YIG-tuned oscillator, and for the Het Band for Models 6617A, 6647A, 6648A, and 6659A. For the 6609A, the Osc 1 procedure provides calibration instructions for its Het Band. A guide directing which procedures apply to which models is provided in Table 5-6. The sweep generator output frequency should be calibrated following maintenance on the A2, A5, and A6-A9 PCBs, and when any of the YIG oscillators are replaced.

Table 5-6. Model Number Guide to Frequency Calibration Adjustments in Paragraph 5-9

MODEL	PERFORM SUBPARAGRAPH(S)
6609A	a. thru d.
6617A	a. thru e.
6621A & 6621A-40	a. thru d., f.
6629A & 6629A-40	a. thru c., f., g.
6637A & 6637A-40	a. thru d., f., g.
6638A	a. thru d., f., g.
6642A	a. thru d., f.
6647A	a. thru g.
6648A	a. thru g.
6653A	a. thru d., f. thru h.
6659A	a. thru h.

a. Set up test equipment as shown in Figure 5-23, and turn the equipment on.

b. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

c. Press RESET on sweeper.

d. Osc 1 Frequency Calibration

CAUTION

To prevent misalignment due to being on the wrong side of the YIG oscillator's hysteresis curve, steps 1 thru 7 should be followed exactly as written.

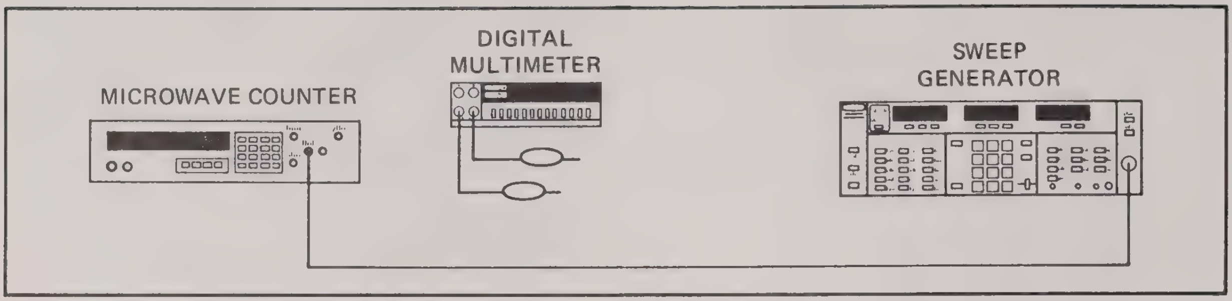


Figure 5-23. Test Equipment Setup for Frequency Calibration

1. Press CW F1 and set for the frequency shown below.

Model	Frequency (GHz)
6609A	0.050
6642A	18.050
All Others	2.050

2. Press CW F2 and set for the frequency shown below.

Model	Frequency (GHz)
6609A	1.950
6642A	26.450
All Others	7.950

3. Press CW F1; wait ≈10 s for the frequency to settle.

4. Using care to prevent the frequency from going below that shown in column 2 below, adjust A6R5 (A6R12 for 6609A) (Figure 5-24) for the frequency shown in column 3 below.

Model	Low-End Frequency (GHz)	Adjustment Frequency (GHz)
6609A	0.010	0.050 ± 1 MHz
6642A	18.000	18.050 ± 1 MHz
All Others	2.000	2.050 ± 1 MHz

5. Press CW F2; wait ≈10 s for the frequency to settle.

6. Using care to prevent the frequency from going above the frequency shown in column 2 below, adjust A6R7 for the frequency shown in column 3 below.

Model	High-End Frequency (GHz)	Adjustment Frequency (GHz)
6609A	2.000	1.950 ± 1 MHz
6642A	26.500	26.450 ± 1 MHz
All Others	8.000	7.950 ± 1 MHz

NOTE

In steps 4 and 6, if the frequency goes below the low-end frequency or above the high-end frequency, the adjustments are invalid. If this happens, repeat steps 1 thru 6.

7. Repeat steps 3 thru 6, as necessary, until the two frequencies are within tolerance.

8. Press FREQUENCY RANGE F1-F2.

9. Press MANUAL SWEEP and set the associated control fully counterclockwise.

10. Adjust A6R3 for a counter reading, as indicated below:

Model	Frequency (GHz)
6609A	0.050 ± 1 MHz
6642A	18.050 ± 1 MHz
All Others	2.050 ± 1 MHz

11. Press CW F0 and set for the frequency shown below:

Model	Frequency (GHz)
6609A	1.000
6642A	22.250
All Others	5.000

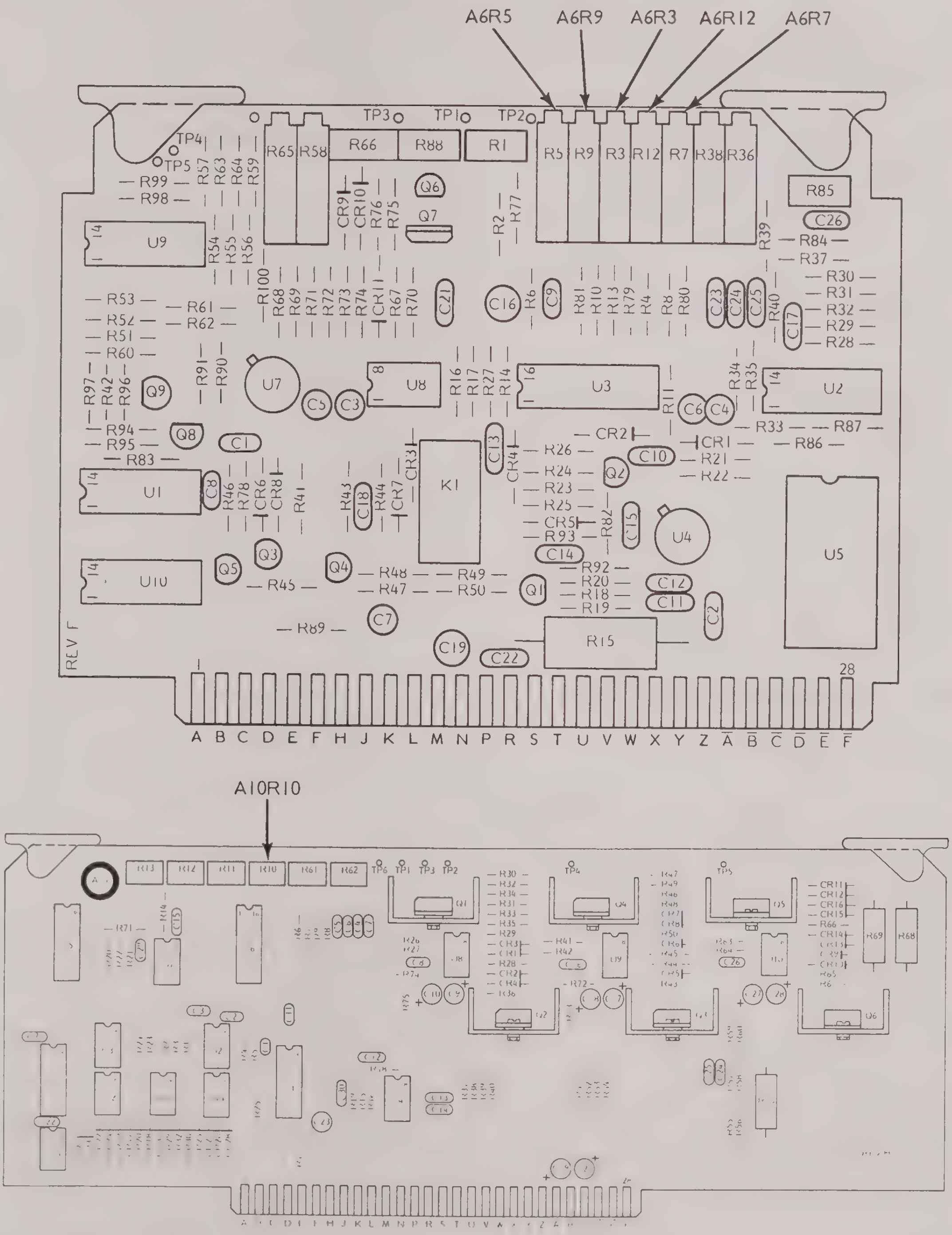

A6R5
A6R9
A6R3
A6R12
A6R7
TP4
TP5
TP3
TP1
TP2
R65
R58
R66
R88
R1
R5
R9
R3
R12
R7
R38
R36
R85
C26
R99
R98
R57
R63
R64
R59
Q6
Q7
CR9
CR10
R76
R75
R2
R77
R39
R84
R37
U9
R54
R55
R56
R100
R68
R69
R71
R72
R73
R74
CR11
R67
R70
C21
C16
R6
C9
R81
R10
R13
R79
R4
R8
R80
C23
C24
C25
R40
C17
R30
R31
R32
R29
R28
R53
R52
R51
R60
R61
R62
R91
R90
U7
U8
R16
R17
R27
R14
U3
R11
R34
R35
U2
R97
R42
R96
Q9
C5
C3
C6
C4
R33
R87
R86
R94
R95
Q8
C1
R83
CR2
CR1
R21
R22
R26
R24
R23
R25
CR5
R93
C10
Q2
C13
CR4
CR3
K1
U1
C8
R46
R78
CR6
CR8
R41
R43
C18
R44
CR7
R82
C15
U4
U5
C14
U10
Q5
Q3
Q4
R45
R48
R47
R49
R50
Q1
R92
R20
R18
R19
C12
C11
C2
R89
C7
C19
C22
R15
REV F
1
28
A B C D E F H J K L M N P R S T U V W X Y Z A̅ B̅ C̅ D̅ E̅ F̅
A10R10
R13
R12
R11
R10
R61
R62
TP6
TP1
TP3
TP2
TP4
TP5

Figure 5-24. Osc 1 Frequency Adjustments

12. After the frequency has settled, observe and record the counter reading.

13. Press FREQUENCY VERNIER INCREASE and hold depressed until the frequency stops increasing.

14. Adjust A6R9 until the counter reads 12.7 ±0.1 MHz (25 ±0.1 MHz for 6642A, 6653A, and 6659A) above the frequency recorded in step 12.

15. Press FREQUENCY VERNIER OFF, and note that the counter reads the frequency recorded in step 12.

16. Press FREQUENCY VERNIER DECREASE and hold depressed until the frequency stops decreasing.

17. Verify that the counter reading decreased by 12.7 ±0.1 MHz (25 ±0.1 MHz for 6642A, 6653A, and 6659A) from the value recorded in step 12.

18. Press FREQUENCY VERNIER OFF.

19. Press FREQUENCY RANGE ΔF F0.

20. Press ΔF and set for 0 MHz.

21. Using the FREQUENCY VERNIER pushbuttons, set the F0 frequency for the counter reading shown below:

Model	Frequency (GHz)
6609A	1.000
6642A	18.050
All Others	5.000

22. Press ΔF and set for 50 MHz.

23. Rotate the MANUAL SWEEP control between its clockwise and counterclockwise ends and note the frequency at each end.

24. Adjust A10R10 on the FM/Attenuator PCB so that the frequency excursions from the step 24 frequency are equal, ±0.5 MHz, at each end of the MANUAL SWEEP control range.

e. .01-2 GHz Band (Heterodyne) Frequency Calibration (Models 6617A, 6647A, 6648A, and 6659A)

1. Press CW F1 and set for 1 GHz.

2. Adjust A6R12 (Figure 5-24) for a counter reading of 1.000 GHz ±1 MHz.

3. Press F1 and sequentially set the frequency for 0.010 GHz, then 2.000 GHz.

4. Verify that the counter reads 0.010 and 1.950 GHz ±10 MHz, respectively, at each end of the band. If not, readjust A6R12 as necessary to achieve this frequency tolerance.

f. Osc 2 Frequency Calibration

CAUTION

To prevent misalignment due to being on the wrong side of the YIG oscillator's hysteresis curve, steps 1 thru 7 should be followed exactly as written.

1. Press RESET.

2. Press FREQUENCY RANGE F1-F2.

3. Press F1 and set for the frequency shown below.

Model	Frequency (GHz)
6642A	26.550
All Others	8.050

4. Press F2 and set for the frequency shown below.

Model	Frequency (GHz)
6642A	39.950
All Others	12.350

5. Press CW F1; wait ≈10 s for the frequency to settle.

6. Using care to prevent the frequency from going below that shown in col-

umn 2 below, adjust A7R2 (Figure 5-25) for the frequency shown in column 3 below.

Model	Low-End Frequency (GHz)	Adjustment Frequency (GHz)
6642A	26.500	26.550 ± 1 MHz
All Others	8.000	8.950 ± 1 MHz

7. Press CW F2; wait ≈10 s for the frequency to settle.

8. Using care to prevent the frequency from going above that shown in column 2 below, adjust A7R7 for the frequency shown in column 3 below.

Model	High-End Frequency (GHz)	Adjustment Frequency (GHz)
6642A	40.000	39.950 ± 1 MHz
All Others	12.400	12.350 ± 1 MHz

NOTE

In steps 6 and 8, if the frequency goes below the low-end frequency or above the high-end frequency, the adjustments are invalid. If this happens, repeat steps 2 thru 8.

9. Repeat steps 5 thru 8, as necessary, until the two frequencies are within tolerance.

10. Press FREQUENCY RANGE F1-F2.

11. Press MANUAL SWEEP and set the associated control fully counterclockwise.

12. Adjust A7R5 for a counter reading as indicated below:

Model	Frequency (GHz)
6642A	26.050 ± 1 MHz
All Others	8.050 ± 1 MHz

13. Press CW F0, and set for the frequency shown below:

Model	Frequency (GHz)
6642A	22.250
All Others	10.000

14. After the frequency has settled, observe and record the counter reading.

15. Press FREQUENCY VERNIER INCREASE and hold depressed until the frequency stops increasing.

16. Adjust A7R9 until the counter reads 12.7 ±0.1 MHz (25 ±0.1 MHz for 6642A, 6653A, 6659A) above the frequency recorded in step 14.

17. Press FREQUENCY VERNIER OFF, and note that the counter reads the frequency recorded in step 14.

18. Press FREQUENCY VERNIER DECREASE and hold depressed until the frequency stops decreasing.

19. Verify that the counter reading decreased by 12.7 ±0.1 MHz (25 ±0.1 MHz for 6642A, 6653A, 6659A) from the value recorded in step 14.

20. Press FREQUENCY VERNIER OFF.

21. Press FREQUENCY RANGE ΔF F0.

22. Press ΔF and set for 0 MHz.

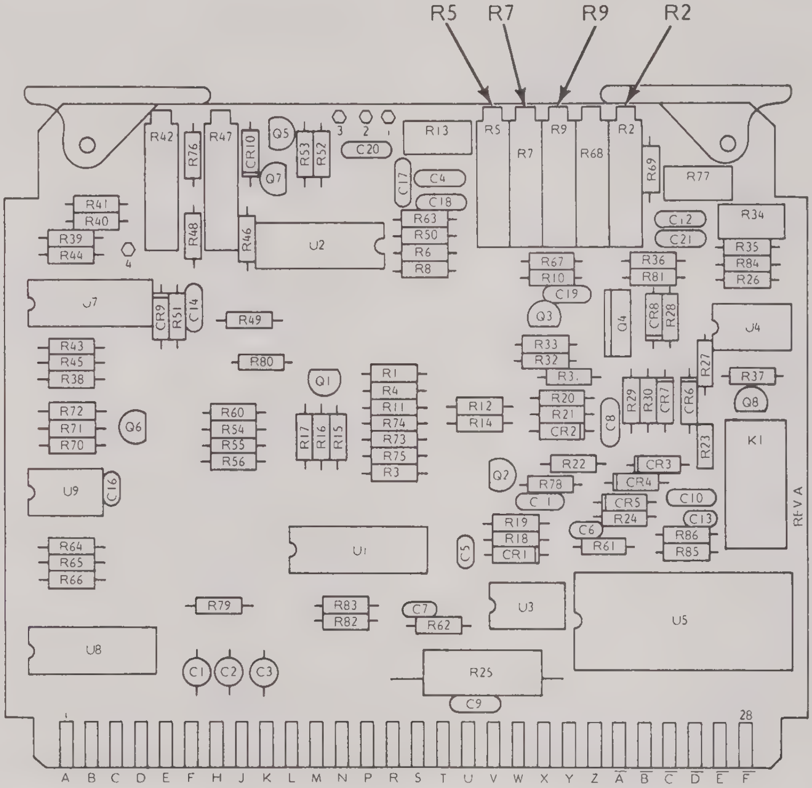
23. Using the FREQUENCY VERNIER pushbuttons, set the F0 frequency for the counter reading shown below:

Model	Frequency (GHz)
6642A	22.250
All Others	10.000

24. Press ΔF and set for 50 MHz.

25. Rotate the MANUAL SWEEP control between its clockwise and counterclockwise ends and note the frequency at each end.

26. Adjust A10R11 on the FM/Attenuator PCB so that the frequency excursions from the step 23 frequency are equal, ±0.5 MHz, at each end of the MANUAL SWEEP control range.


R5
R7
R9
R2
R42
R76
R47
CR10
Q5
R53
R52
Q7
3
2
1
C20
R13
C17
C4
C18
R5
R7
R9
R68
R2
R69
R77
R41
R40
R39
R44
4
R48
R46
U2
R63
R50
R6
R8
R67
R10
C19
R36
R81
C12
C21
R34
R35
R84
R26
U7
CR9
R51
C14
R49
Q3
Q4
CR8
R28
U4
R43
R45
R38
R80
Q1
R1
R4
R11
R74
R73
R75
R3
R33
R32
R31
R27
R37
R29
R30
CR7
CR6
Q8
R72
R71
R70
Q6
R60
R54
R55
R56
R17
R16
R15
R12
R14
R20
R21
CR2
C8
R23
K1
R22
CR3
Q2
R78
CR4
U9
C16
C1
CR5
C10
R24
C13
REV A
R19
R18
CR1
C6
R61
R86
R85
R64
R65
R66
U1
C5
R79
R83
R82
C7
R62
U3
U5
U8
C1
C2
C3
R25
C9
1
28
A B C D E F H J K L M N P R S T U V W X Y Z $\overline{A}$ $\overline{B}$ $\overline{C}$ $\overline{D}$ $\overline{E}$ $\overline{F}$

A7, A8 YIG Driver PCBs

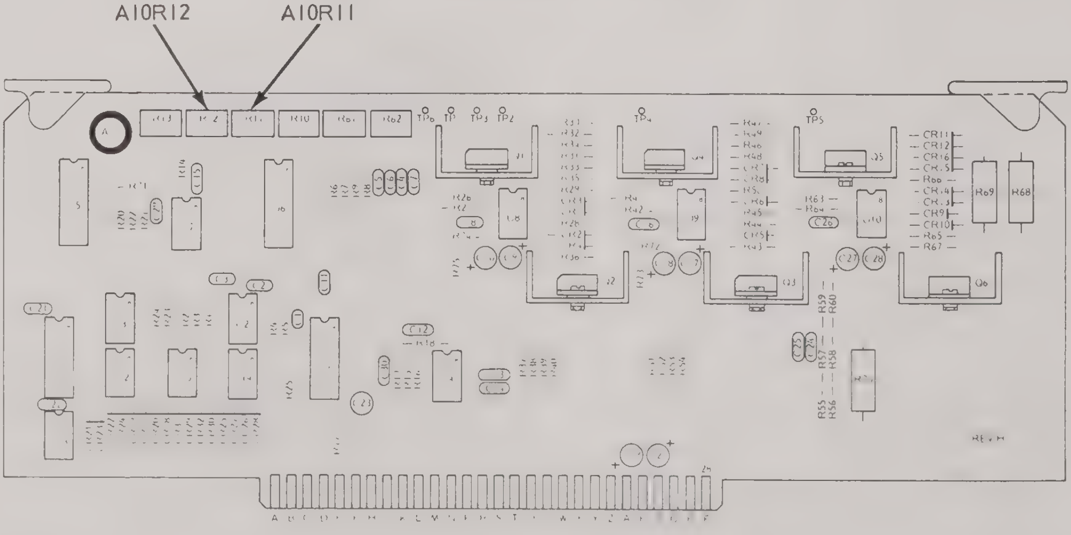

A10R12
A10R11
A
TP6
TP
TP3
TP2
TP4
TP5
R10
CR11
CR12
CR16
CR15
CR9
CR10
R65
R67
R69
R68
Q5
Q6
Q3
R63
R64
C26
C27
C28
R59
R60
R57
R58
R55
R56
C12
C23
C21
REV H

Figure 5-25. 8-12.4 and 12.4-18.6 (or 20) GHz Band (Osc 2 and 3) Frequency Adjustments

g. Osc 3 Frequency Calibration

CAUTION

To prevent misalignment due to being on the wrong side of the YIG oscillator's hysteresis curve, steps 1 thru 7 should be followed exactly as written.

1. Press RESET.
2. Press FREQUENCY RANGE F1-F2.
3. Press F1 and set for 12.450 GHz.
4. Press F2 and set for the frequency shown below.

Model	Frequency (GHz)
6638A/6648A	19.950
6653A/6659A	17.950
6637A/6647A	18.550

5. Press CW F1; wait ≈10 s for the frequency to settle.
6. Using care to prevent the frequency from going below 12.400 GHz, adjust A8R2 (Figure 5-25) for 12.450 GHz ±1 MHz, as indicated on the counter.
7. Press CW F2; wait ≈10 s for the frequency to settle.
8. Using care to prevent the frequency from going above that shown in column 2 below, adjust A8R7 for the frequency shown in column 3 below:

Model	High-End Frequency (GHz)	Adjustment Frequency (GHz)
6638A/6648A	20.000	19.950 ±1 MHz
6653A/6659A	18.000	17.950 ±1 MHz
6637A/6647A	18.600	18.550 ±1 MHz

NOTE

In steps 6 and 8, if the frequency goes below the low-end frequency or above the high-end frequency, the adjustments are invalid. If this happens, repeat steps 5 thru 8.

9. Repeat steps 5 thru 8, as necessary, until the two frequencies are within tolerance.
10. Press FREQUENCY RANGE F1-F2.
11. Press MANUAL SWEEP and set the associated control fully counterclockwise.
12. Adjust A8R5 for a reading of 12.450 GHz ±1 MHz, as indicated on the counter.
13. Press CW F0, and set for 15 GHz.
14. After the frequency has settled, observe and record the counter reading.
15. Press FREQUENCY VERNIER INCREASE and hold depressed until the frequency stops increasing.
16. Adjust A8R9 until the counter reads 12.7 ±0.1 MHz (25 ±0.1 MHz for 6653A and 6659A) above the frequency recorded in step 14.
17. Press FREQUENCY VERNIER OFF, and note that the counter reads the frequency recorded in step 14.
18. Press FREQUENCY VERNIER DECREASE and hold depressed until the frequency stops decreasing.
19. Verify that the counter reading decreased by 12.7 ±0.1 MHz (25 ±0.1 MHz for 6653A and 6659A) below the value recorded in step 14.
20. Press FREQUENCY VERNIER OFF.
21. Press FREQUENCY RANGE ΔF F0.
22. Press ΔF and set for 0 MHz.
23. Using the FREQUENCY VERNIER pushbuttons, set the F0 frequency for a counter reading of 15.000 GHz.
24. Press ΔF and set for 50 MHz.

25. Rotate the MANUAL SWEEP control between its clockwise and counterclockwise ends and note the frequency at each end.

26. Adjust A10R12 on the FM/Attenuator PCB so that the frequency excursions from 15 GHz are equal, ± 0.5 MHz, at each end of the MANUAL SWEEP control.

h. Osc 4 Frequency Calibration

CAUTION

To prevent misalignment due to being on the wrong side of the YIG oscillator's hysteresis curve, steps 1 thru 8 should be followed exactly as written.

1. Press RESET.

2. Press FREQUENCY RANGE F1-F2.

3. Press F1 and set for 18.050 GHz.

4. Press F2 and set for 26.450 GHz.

5. Press CW F1; wait ≈10 s for the frequency to settle.

6. Using care to prevent the frequency from going below 18.000 GHz, adjust A8R2 (Figure 5-25) for 18.050 GHz ±1 MHz, as indicated on the counter.

7. Press CW F2; wait ≈10 s for the frequency to settle.

8. Using care to prevent the frequency from going above 26.500 GHz, adjust A8R7 for 26.450 GHz ±1 MHz, as indicated on the counter.

NOTE

In steps 6 and 8, if the frequency goes below 18.000 or above 26.500 GHz, the adjustments are invalid. If this happens, repeat steps 5 thru 8.

9. Repeat steps 5 thru 8, as necessary, until the two frequencies are within tolerance.

10. Press FREQUENCY RANGE F1-F2.

11. Press MANUAL SWEEP and set the associated control fully counterclockwise.

12. Adjust A8R5 for a reading of 18.050 GHz ±1 MHz, as indicated on the counter.

13. Press CW F0, and set for 22.250 GHz.

14. After the frequency has settled, observe and record the counter reading.

15. Press FREQUENCY VERNIER INCREASE and hold depressed until the frequency stops increasing.

16. Adjust A8R9 until the counter reads 25.0 ±0.1 MHz above the frequency recorded in step 14.

17. Press FREQUENCY VERNIER OFF, and note that the counter reads the frequency recorded in step 14.

18. Press FREQUENCY VERNIER DECREASE and hold depressed until the frequency stops decreasing.

19. Verify that the counter reading decreased by 25.0 ±0.1 MHz below the value recorded in step 14.

20. Press FREQUENCY VERNIER OFF.

21. Press FREQUENCY RANGE ΔF F0.

22. Press ΔF and set for 0 MHz.

23. Using the FREQUENCY VERNIER pushbuttons, set the F0 frequency for a counter reading of 15.000 GHz.

24. Press ΔF and set for 50 MHz.

25. Rotate the MANUAL SWEEP control between its clockwise and counterclockwise ends and note the frequency at each end.

26. Adjust A10R13 on the FM/Attenuator PCB so that the frequency excursions from 22.250 GHz are equal, ± 0.5 MHz, at each end of the MANUAL SWEEP control range.

5-10 2-8 GHz BAND (OSC 1) TRACKING FILTER ADJUSTMENTS (Models 6617A, 6647A, 6648A, and 6659A)

This paragraph provides instructions for adjusting the 2-8 GHz band (Osc 1) tracking filter. These adjustments should be performed following maintenance on the A6 PCB or when the power output of the sweep generator is below its specified tolerance in the 2-8 GHz band.

a. Connect test equipment as shown in Figure 5-26, and turn the equipment on.

b. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

c. Press RESET on sweeper.

d. Press FREQUENCY RANGE F1-F2.

e. Press F1 and set for 2 GHz.

f. Press F2 and set for 8 GHz.

g. Press INTERNAL leveling to the off position (indicator not lit).

h. On the network analyzer,

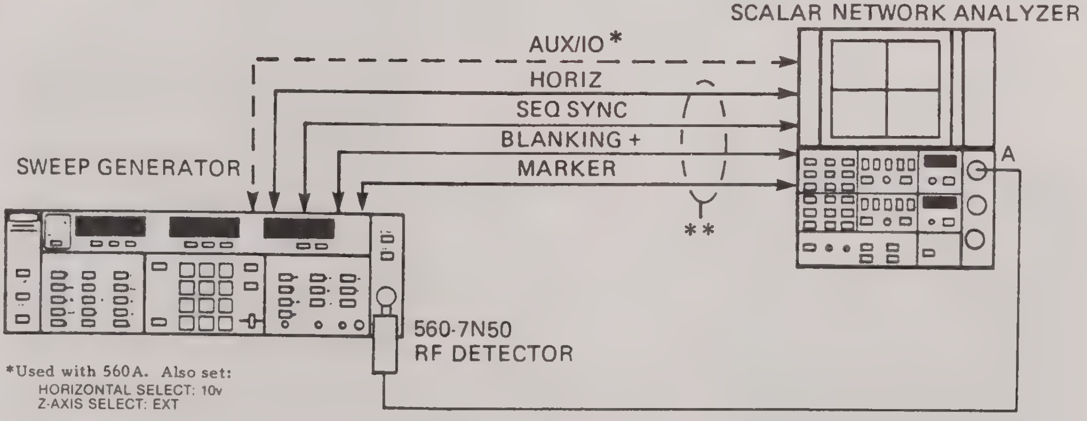
  1. press Channel A REF POS LOCATE and adjust the associated SET potentiometer so that the reference line is positioned on the display's center graticule line;

  2. release REF POS LOCATE;

  3. a trace similar to that shown in Figure 5-27 should be observed.

i. On the sweeper,

  1. alternately adjust A6R36 and A6R38 (Figure 5-31) to obtain maximum out-



*Used with 560A. Also set:
HORIZONTAL SELECT: 10v
Z-AXIS SELECT: EXT

**560 only

Initial Control Settings

Scalar Network Analyzer

CHANNEL A ON: On
INPUT: A
MEMORY: Off
dB PER DIVISION: 2
REFERENCE dB/dBm: dBm
SET (screwdriver pot): Midrange
OFFSET: +10.2
CHANNEL B: Not used
MARKER THRESHOLD: Off
REAL TIME: On
SMOOTHING: Off

Figure 5-26. Test Equipment Setup for Tracking Filter Adjustments

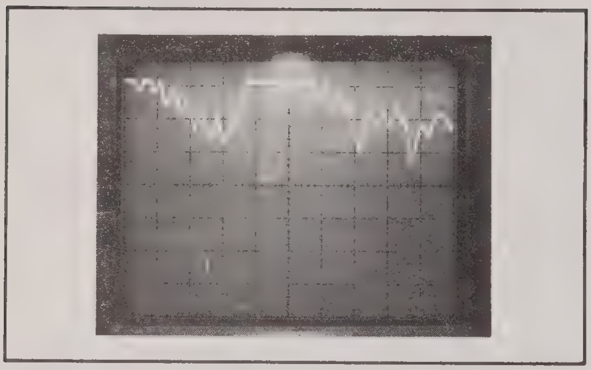


Figure 5-27. F1-F2 Sweep, Unleveled Power

put power across the frequency band. A6R36 will adjust power at the low and A6R38 at the high end of the frequency band;

2. press INTERNAL leveling;
3. press FULL.

j. On the network analyzer, press Channel A .2 dB PER DIVISION.

k. On the sweeper,

1. press LEVEL;
2. operate the INCREASE/DECREASE lever to place the minimum-power point of the displayed trace (Figure 5-28) on the center graticule line.

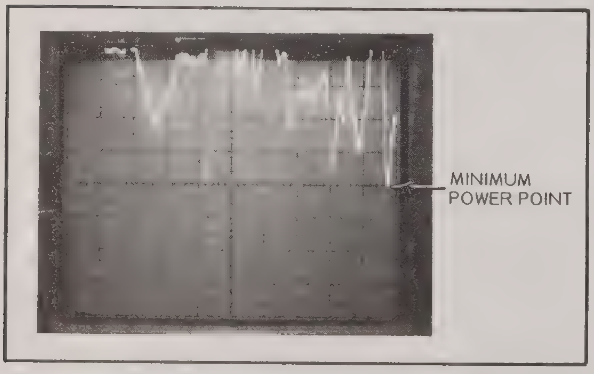


Figure 5-28. Minimum Power Point on Leveled Output Power Signal

3. press ΔF F0;
4. press ΔF and set for 50 MHz;
5. press F0 and set for 2.000 GHz.

l. On network analyzer, press Channel A .5 dB PER DIVISION. The trace should appear on the top half of the display (Figure 5-29).

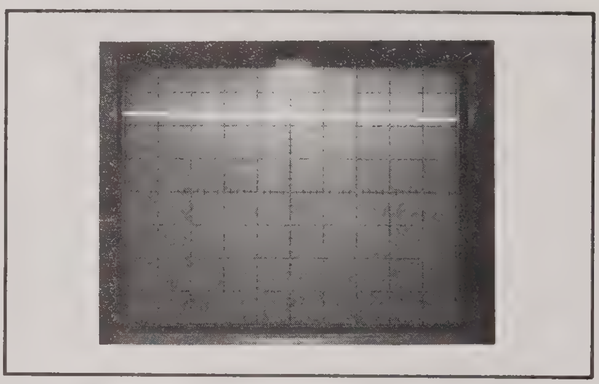


Figure 5-29. Narrow-Band Sweep, Leveled Power

m. On sweeper, move the INCREASE/DECREASE lever toward INCREASE so that the F0 frequency slowly advances, as indicated on the LED numeric display.

n. Observe the network analyzer display and ensure that the trace does not go unleveled (Figure 5-30) at any frequency between 2 and 8 GHz.

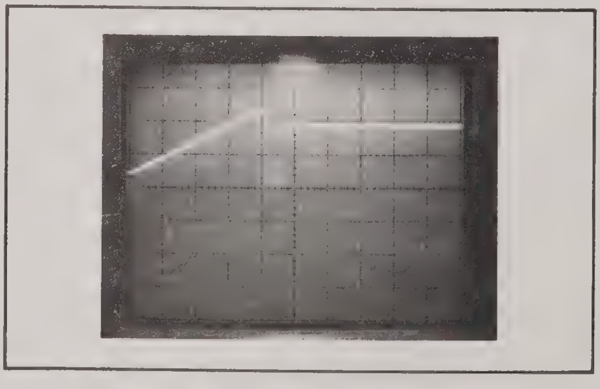


Figure 5-30. Narrow-Band Sweep, Unleveled Power

o. If the trace goes unleveled, adjust A10R62 until it becomes leveled (Figure 5-29).

p. Using the INCREASE/DECREASE lever, recheck the ΔF F0 narrow-band sweep and ensure that it has leveled power at all frequencies between 2 and 8 GHz.

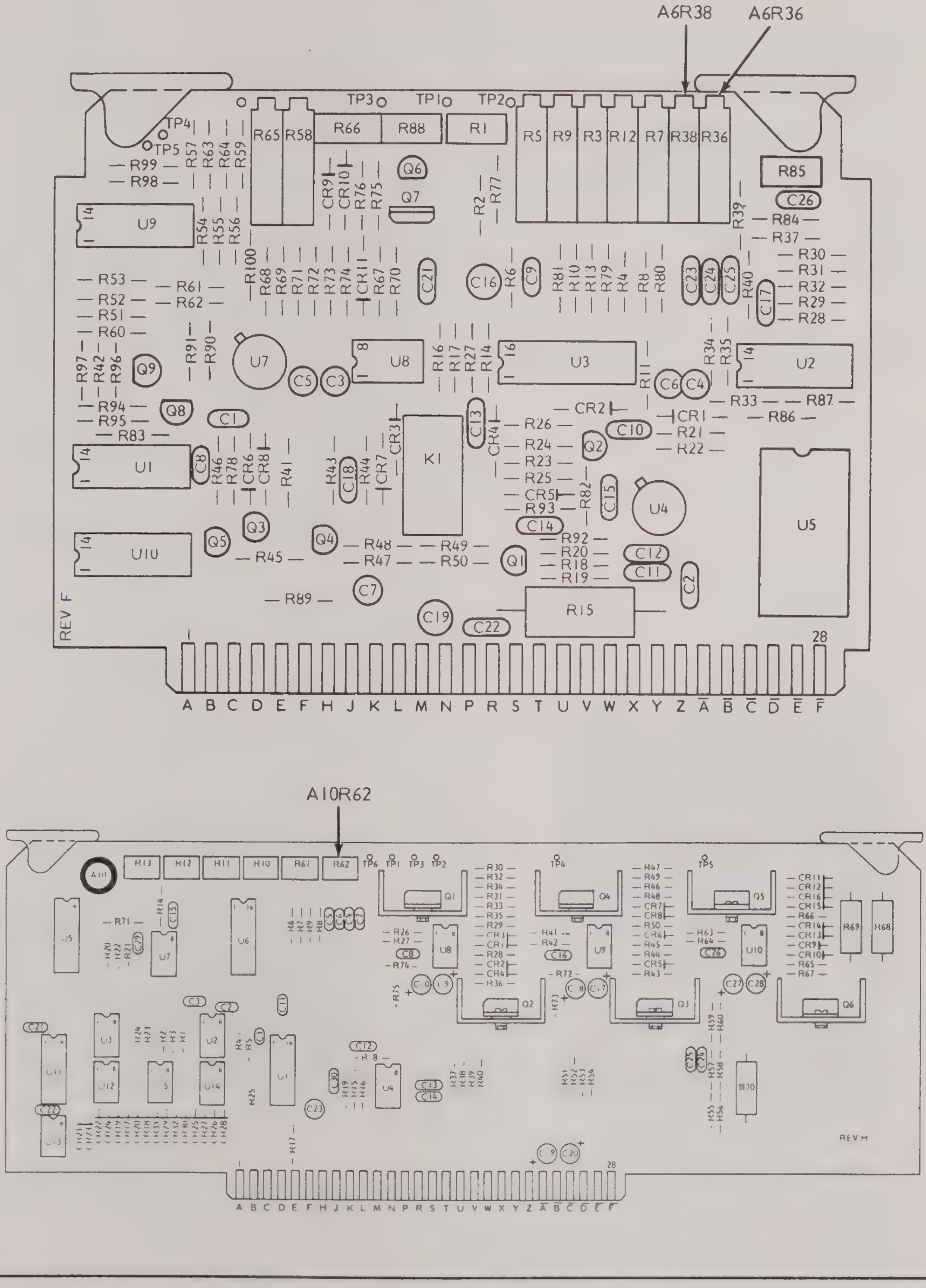

A6R38
A6R36
TP1
TP2
TP3
TP4
TP5
REV F
28
A B C D E F H J K L M N P R S T U V W X Y Z A̅ B̅ C̅ D̅ E̅ F̅
A10R62
A10
REV H

Figure 5-31. Tracking Filter Adjustments

5-11 SWEEP RATE COMPENSATION ADJUSTMENT

This paragraph provides instructions for adjusting the sweep generator so that the frequency shift is minimum when the sweep rate is varied. This adjustment should be performed following maintenance on any of the A6-A9 PCBs, or when a frequency shift is detected while increasing or decreasing sweep speed.

a. Connect the test equipment as shown in Figure 5-33, and turn the equipment on.

b. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

c. Press RESET.

d. Press INTERNAL leveling to off (indicator not lit).

e. Press SWEEP TIME and set for 10 ms.

f. Adjust oscilloscope vertical control to obtain a waveform similar to that shown in Figure 5-32.

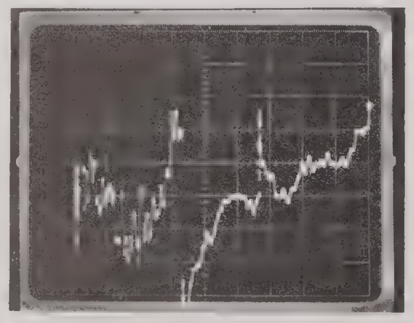


Figure 5-32. Model 6647A Unleveled Full-Band Sweep

g. While monitoring the oscilloscope,

   1. select a perturbation to observe in the Osc 1 (2-8 GHz) band (Figure 5-34),

   2. alternately change the SWEEP TIME between 10 and 30 ms, and

   3. adjust A6R1 (Figure 5-35) for a minimum frequency shift, as indicated by the selected perturbation.

h. Repeat step g. for the applicable Osc 2, Osc 3, and Osc 4 YIG bands. Adjust A7R13 for Osc 2, A8R13 for Osc 3, and A9R13 for Osc 4.

5-12 ALC LOOP CALIBRATION

This paragraph provides instructions for calibrating the sweep generator's ALC (automatic level control) loop. The procedure in paragraph 5-12.1 covers all models except the 26.5 to 40 GHz band of the 6642A. This band is covered in paragraph 5-12.2. The ALC loop calibration procedures should be performed following the repair or replacement of any of the ALC loop components.

5-12.1 ALC Loop Adjustments (All Models Except 6642A, 26.5 to 40 GHz Band)

This paragraph describes the ALC loop adjustments, which are divided into four groups: ALC Bandwidth, RF Slope, Power Level, and Coupler/Het detector Tracking for Models 6617A, 6647A, 6648A, and 6659A.

a. ALC Loop Bandwidth Adjustments

   1. Set up the test equipment as shown in Figure 5-36, and turn the equipment on.

   2. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.

   3. Adjust the function generator to supply the sweeper with a 10 kHz, 0-10V square wave.

   4. Press RESET on sweeper.

   5. Het Band (A4/A6 PCBs) Loop Adjustment (Models 6609A, 6617A, 6647A, 6648A, and 6659A)

      (a) Press CW F1 and set for 1.000 GHz.

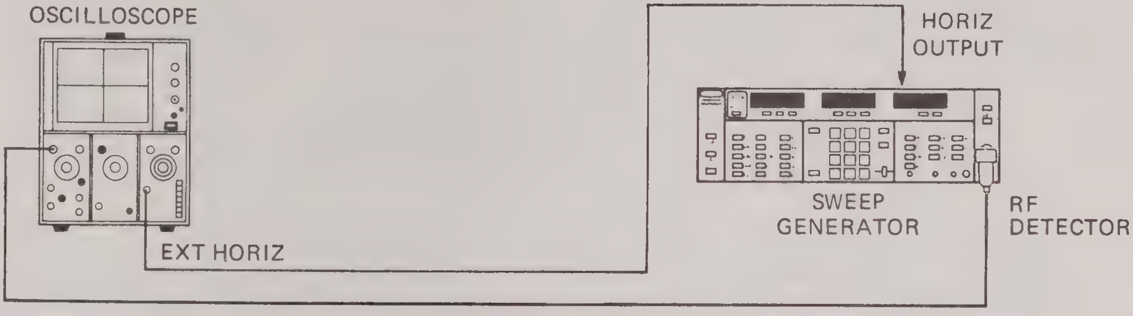

OSCILLOSCOPE
HORIZ OUTPUT
SWEEP GENERATOR
RF DETECTOR
EXT HORIZ

Figure 5-33. Test Equipment Setup for Sweep Rate Compensation Adjustments

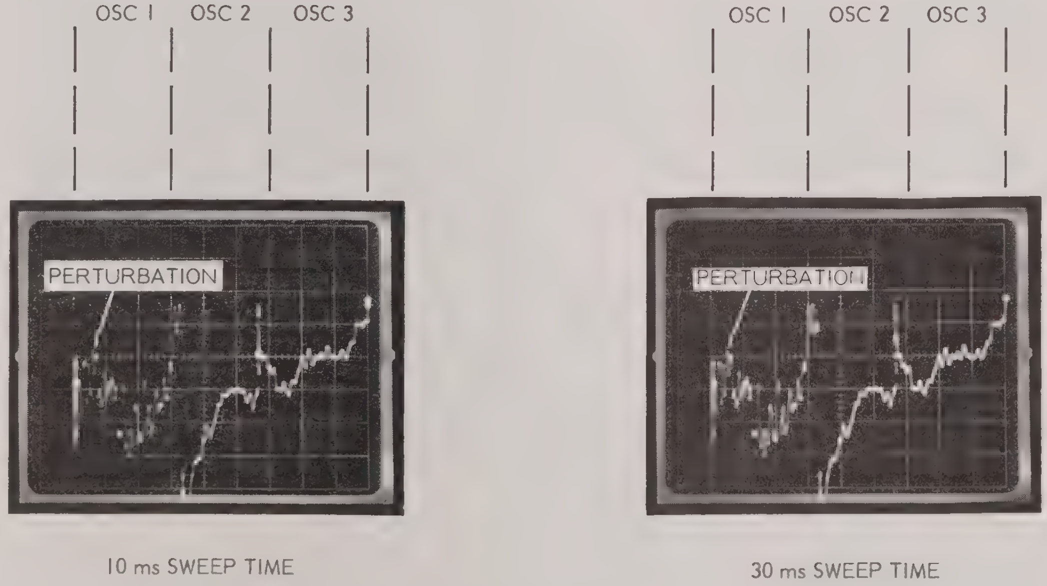

OSC 1
OSC 2
OSC 3
PERTURBATION
OSC 1
OSC 2
OSC 3
PERTURBATION
10 ms SWEEP TIME
30 ms SWEEP TIME

Figure 5-34. Waveforms Showing Frequency Shift with Sweep Time Change

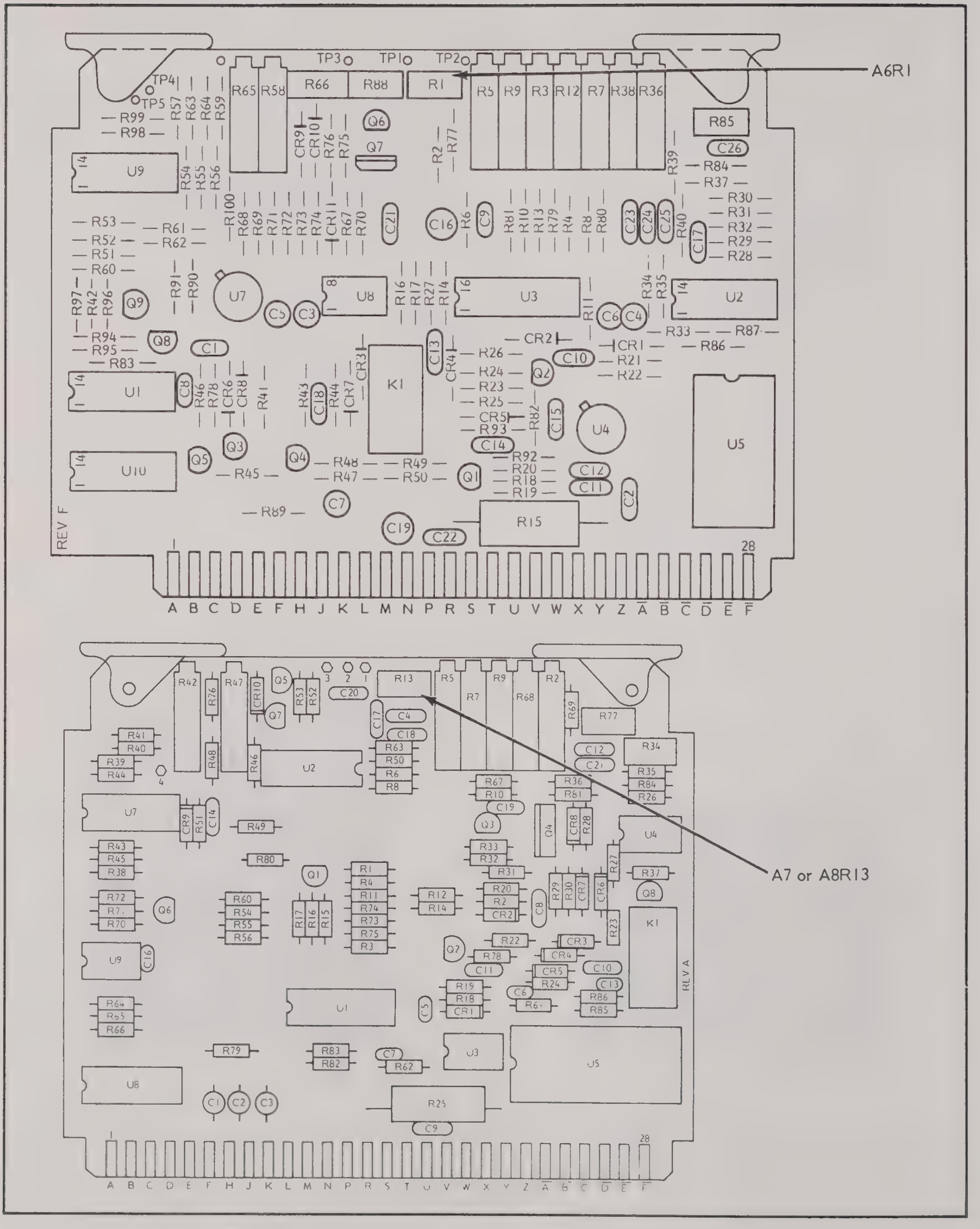

A6R1
A7 or A8R13
TP1
TP2
TP3
TP4
TP5
R65
R58
R66
R88
R1
R5
R9
R3
R12
R7
R38
R36
R85
C26
U9
U8
U7
U3
U2
U1
U10
U5
U4
K1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C21
C22
C23
C24
C25
R15
REV F
REV A
1
28
A B C D E F H J K L M N P R S T U V W X Y Z A B C D E F
R13
R42
R47
R2
R68
R77
R34
U1
U2
U3
U4
U5
U6
U7
U8
U9
R25

Figure 5-35. Sweep Rate Compensation Adjustments

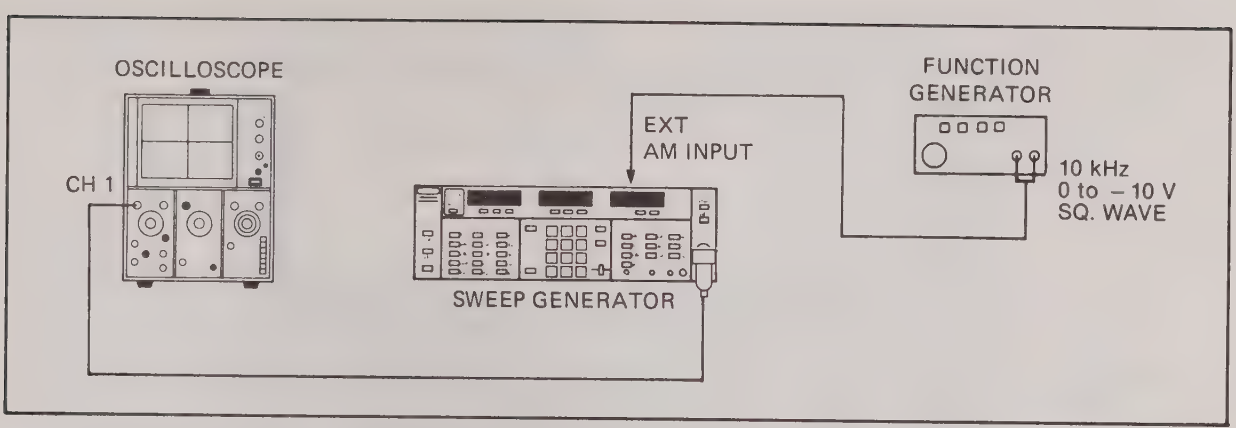


Figure 5-36. Test Equipment Setup for Making ALC Loop Bandwidth Adjustments

(b) Adjust the oscilloscope vertical and horizontal controls to display a square wave similar to that shown in Figure 5-37.

NOTE

Ensure that the UNLEVELED indicator is not lit, which may happen if the square wave is riding a dc offset.

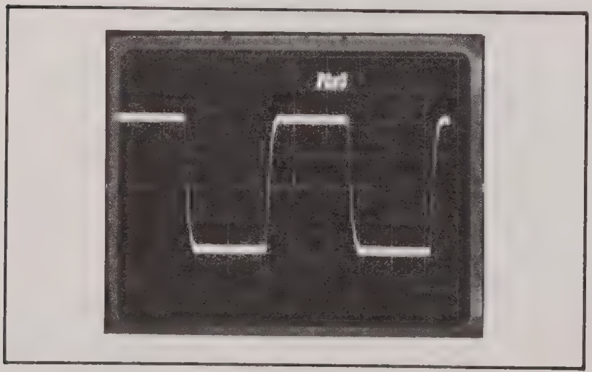


Figure 5-37. ALC Loop Square Wave

(c) Adjust A4R124 and A6R66 (Figure 5-38) for a square wave with no overshoot and a rise time of less than 20 μs.

(d) For 6609A, go to step 11; for all other models, go to step 6.

6. Osc 1 (A4/A6 PCBs) Loop Adjustment (All models except 6609A, 6629A and 6629A-40)*

(a) Press CW F1 and set as shown below:

Model	Frequency (GHz)
6642A	22.250
All Others	5.000

(b) Adjust the oscilloscope vertical and horizontal controls to display a square wave similar to that shown in Figure 5-37.

NOTE

Ensure that the UNLEVELED indicator is not lit, which may happen if the square wave is riding a dc offset.

(c) Adjust A4R123 and A6R66 (Figure 5-36) for a square wave with no overshoot and a rise time of less than 20 μs.

(d) For 6617A, go to step 11; for 6642A go to paragraph 5-12.2; and for all other models, go to step 8.

7. Osc 2 (A4/A7 PCBs) Loop Adjustment (Models 6629A and 6629A-40)

(a) Press CW F1 and set for 10 GHz.

NOTE

Ensure that the UNLEVELED indicator is not lit, which may happen if the square wave is riding a dc offset.

(b) Adjust the oscilloscope vertical and horizontal controls to dis-

---

*For 6629A and 6629A-40, go to step 7.

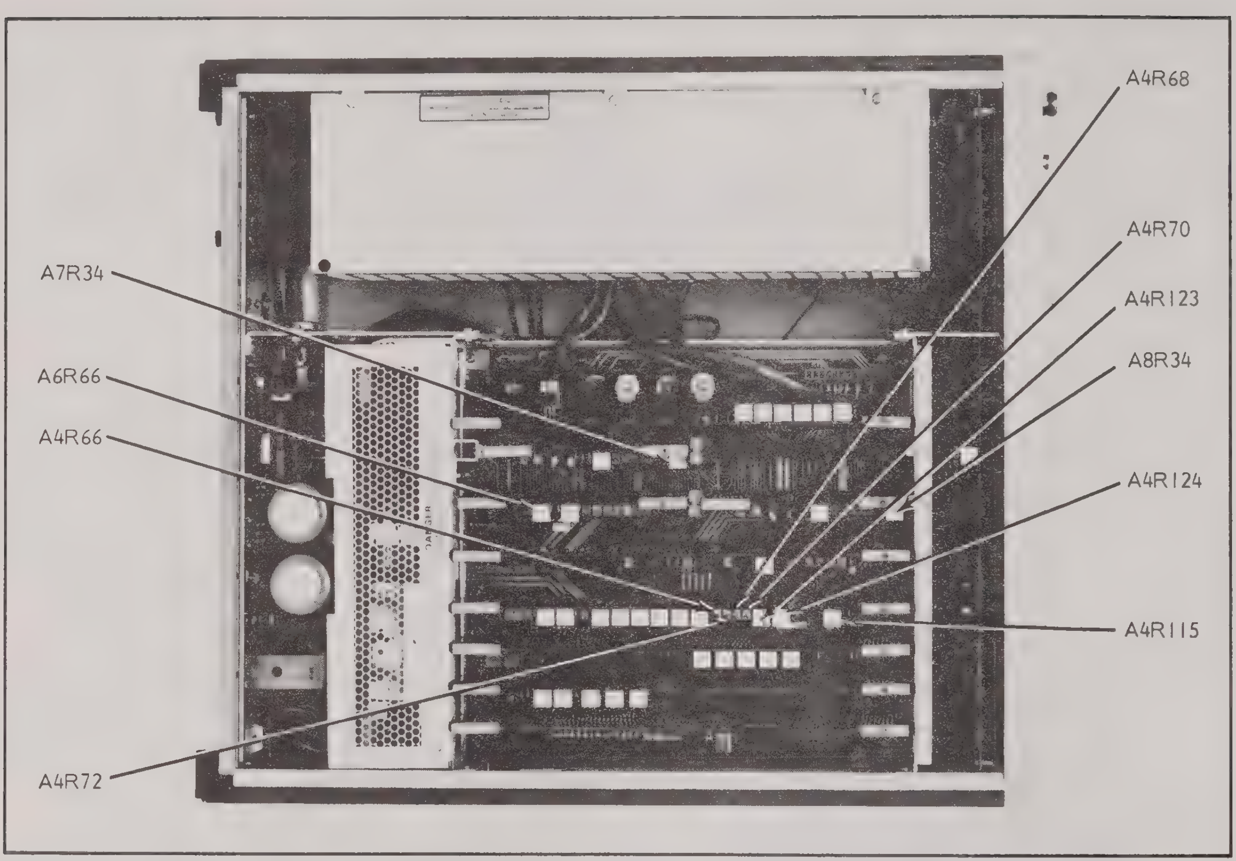


Figure 5-38. ALC Loop Adjustments

play a square wave similar to that shown in Figure 5-37.

(c) Adjust A4R123 and A7R34 (Figure 5-38) for a square wave with no overshoot and a rise time of less than 20 µs.

8. Osc 2 (A7 PCB) Loop Adjustment (All models except 6609A, 6617A, 6629A, and 6629A-40)

(a) Press F1 and set for 10.000 GHz.

(b) Adjust A7R34 for the best square-wave response.

(c) For 6621A and 6621A-40, go to step 11; for all other models, go to step 9.

9. Osc 3 (A8 PCB) Loop Adjustment (Models 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, and 6659A

(a) Press F1 and set for 15 GHz.

(b) Adjust A8R34 for a square wave with no overshoot and a rise time of less than 20 µs.

(c) For all models except 6653A and 6659A, go to step 11; for these two models, go to step 10.

10. Osc 4 (A9 PCB) Loop Adjustment (Models 6653A and 6659A)

(a) Press F1 and set for 22.25 GHz.

(b) Press LEVEL and set for -1 dBm.

(c) Adjust A9R34 for a square wave with no overshoot and a rise time of less than 20 µs.

(d) Go to step 11.

11. Press POWER to OFF, and disconnect the test equipment.

b. RF SLOPE Adjustment (All models except 6642A)*

1. Set up the test equipment as shown in Figure 5-39, and turn the equipment on.

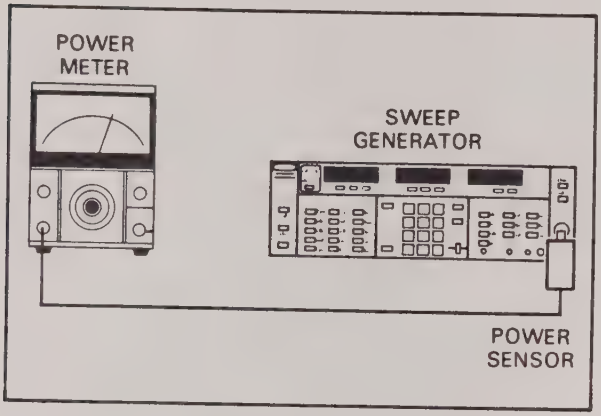


Figure 5-39. Test Equipment Setup for RF SLOPE and Power Level Adjustments

NOTE

Ensure that the RF SLOPE control is OFF.

2. Press RESET.
3. Press LEVEL and set for 5 dB below the power level indicated on the LEVEL LED display.
4. Press CW F1 and set as shown below:

Model	Frequency (GHz)
6609A	0.050
6629A and 6629A-40	8.050
All Others	2.050

5. Record the power meter reading.

NOTE

Ensure that the CAL FACTOR control on the power is set correctly for the frequency to be measured.

6. Press CW F2 and set as shown below:

Model	Frequency (GHz)
6609A	1.950
6617A	7.950
6621A and 6621A-40	12.350
6629A, 6629A-40, 6637A, 6637A-40, and 6647A	18.550
6638A and 6648A	19.950
6653A and 6659A	26.450

7. Record the power meter reading.
8. Alternately press CW F1 and CW F2, and adjust A4R115 (Figure 5-38) for equal power at each CW frequency.

c. Power Level Adjustments (All models except 6642A)**

1. Press RESET.
2. Press F1 and set as shown below:

Model	Frequency (GHz)
6609A	0.050
6629A and 6629A-40	8.050
All Others	2.050

3. As indicated on the power meter, adjust A4R66 (Figure 5-38) for the power level indicated on the LEVEL LED display.
4. Press LEVEL and set for 9.9 dB below the power level indicated on the LEVEL LED display.
5. Adjust A4R72 for the power level indicated on the LEVEL LED display.
6. Repeat steps 2 thru 5 as necessary until the steps 2 and 4 power levels are ±0.1 dB.
7. Press POWER to OFF, and disconnect the test equipment.

---

*The RF slope adjustment for the 6642A is described in paragraph 5-12.2.

**The power level adjustments for the 6642A are described in paragraph 5-12.1

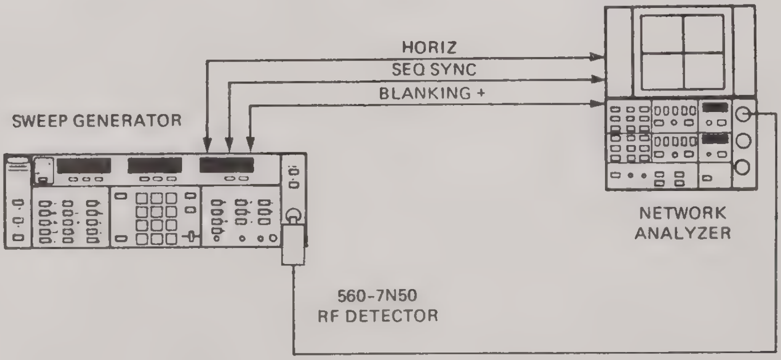
d. Coupler and Het Detector Tracking Adjustment (Models 6617A, 6647A, 6648A and 6659A)

1. Set up the test equipment as shown in Figure 5-40, and turn the equipment on.
2. On the sweeper,
   - (a) press FREQUENCY RANGE ΔF F0;
   - (b) press F0 and set for 1 GHz;
   - (c) press ΔF and set for 1 GHz.
3. On the network analyzer, press REF POS LOCATE, and adjust the SET screwdriver potentiometer to position the reference line to center-screen.
4. On the sweeper,
   - (a) press LEVEL and set for 10 dBm;
   - (b) Adjust A4R142 for a level trace on the network analyzer;
   - (c) press F0 and set for 2 GHz.
   - (d) adjust A4R68 until the power levels on both sides of the 2 GHz center frequency are approximately equal, as observed on the network analyzer.
5. On the network analyzer, readjust the OFFSET control for a 0 dBm reading on the OFFSET dB display.
6. On the sweeper,
   - (a) press LEVEL and set for 0 dBm.
   - (b) adjust A4R70 until the power levels on both sides of the 2 GHz center frequency are approximately equal, as observed on the network analyzer.

NOTE

If unable to obtain equal traces with A4R70 (above), adjust the A4U4 offset potentiometer (Figure 5-41); then readjust A4R70 as described above.

7. While observing the network analyzer display and using the 560 OFFSET control to keep the trace on the screen, use the INCREASE/DECREASE lever on the sweeper to vary the power level back and forth between 0 and 10 dBm.

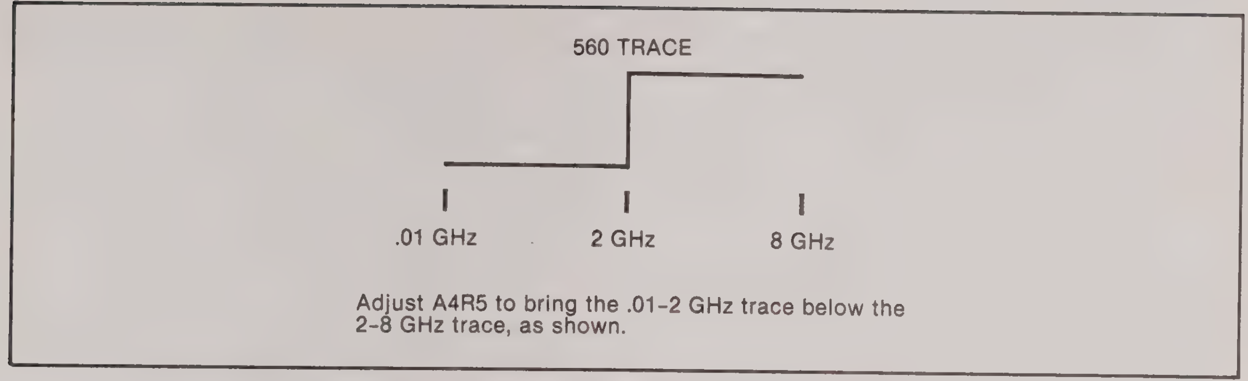


560 Control Settings

CHANNEL A ON: On
MEMORY: OFF
dB PER DIVISION: .5
REFERENCE dB/dBm: dBm
OFFSET 10 dBm

CHANNEL B ON: Off
REAL TIME: On
SMOOTHING: Off
MARKERS: Off

Figure 5-40. Test Equipment Setup for Detector Tracking Adjustment


560 TRACE
.01 GHz
2 GHz
8 GHz

Adjust A4R5 to bring the .01-2 GHz trace below the 2-8 GHz trace, as shown.

Figure 5-41. Potentiometer A4R5 Adjustments

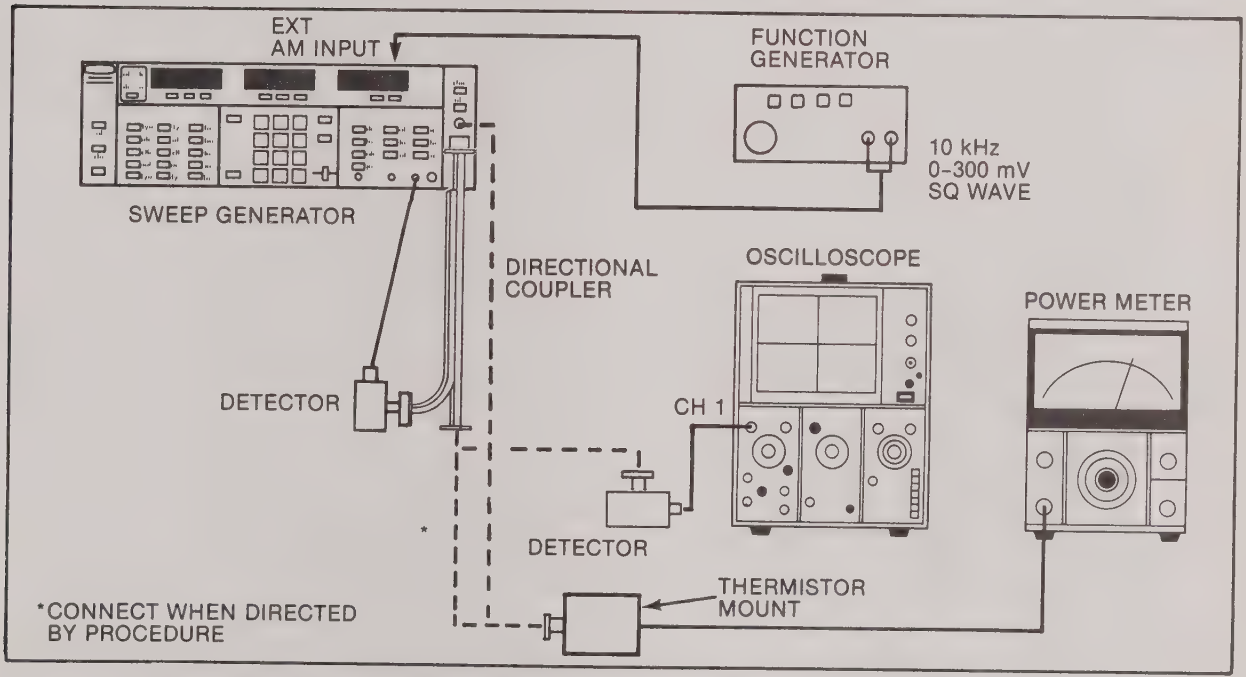

EXT
AM INPUT
FUNCTION
GENERATOR
10 kHz
0-300 mV
SQ WAVE
SWEEP GENERATOR
DIRECTIONAL
COUPLER
OSCILLOSCOPE
POWER METER
DETECTOR
CH 1
*
DETECTOR
THERMISTOR
MOUNT
*CONNECT WHEN DIRECTED
BY PROCEDURE

Figure 5-42. Model 6642A, Test Equipment Setup for Making ALC Loop Calibration Adjustments

8. Verify that the power levels on both sides of the 2 GHz center frequency are equal, ±0.5 dB. If they are unequal between 0 and 5 dBm, readjust A4R68. Conversely, if they are unequal between 5 and 10 dBm, readjust A4R70.

5-12.2 ALC Loop Adjustments (Model 6642A, 26.5 to 40 GHz Band)

The ALC loop adjustments for the 6642A are divided into three groups: ALC Bandwidth, RF Slope, and Power Level.

a. ALC Loop Bandwidth Adjustments (26.5-40 GHz Band)

1. Set up the test equipment as shown in Figure 5-42 (oscilloscope connected to the directional coupler); turn the equipment on.
2. Remove the top cover from the sweep generator (sweeper). Refer to paragraph 7-3.1 for instructions, if necessary.
3. Adjust the function generator to

supply the sweeper with a 10 kHz, 0-300 mV square wave.

4. Press RESET on sweeper.
5. Press CW F1 and set for 30 GHz.
6. Press LEVEL and set for -5 dBm.
7. Place EXT ALC GAIN control to midrange.
8. Adjust the oscilloscope vertical and horizontal controls to display a square wave similar to that shown in Figure 5-43.
9. Alternately adjust A4R124 and A7R34 (Figure 5-38) for the best square-wave response. The square wave should resemble Figure 5-43.

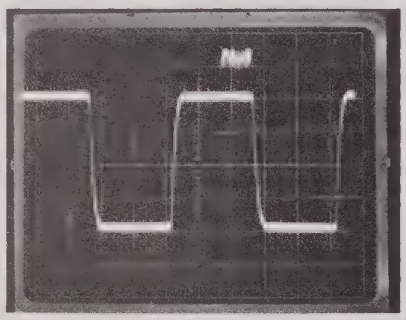


Figure 5-43. ALC Loop Square Wave

10. With the oscilloscope, verify the following signal parameters at 0 and -10 dBm power-level settings.
    - Overshoot: <20%
    - Rise Time: <7μs.
11. Verify the square-wave response at the upper and lower limits of the 10 dBm leveled-power range; see Table 5-7.

b. RF SLOPE Adjustment

1. Disconnect oscilloscope from the directional coupler and connect the power meter's R486A Thermistor Mount in its place.
2. Press LEVEL and set for -5 dBm.
3. Press F1 and set for 40.000 GHz.
4. Record the power meter reading.
5. Disconnect the R486A Thermistor Mount from the power meter, and connect a K482A Thermistor Mount between the power meter and the 18-26.5 GHz RF OUTPUT connector on the sweeper.
6. Press F1 and set for 18.000 GHz.
7. Record the power meter reading.
8. Adjust A4R115 (Figure 5-38) for equal power at 18 and 26.5 GHz.

c. Power Level Adjustments

1. Press LEVEL and set for +3 dBm.
2. Adjust A4R66 for a power meter reading of +3.0 dBm.
3. Set LEVEL for -7.0 dBm.
4. Adjust A4R72 for a power meter reading of -7.0 dBm.
5. Repeat steps 2 thru 5 as necessary until the power levels are +3.0 dBm and -7.0 dBm respectively, ±0.1 dB.
6. Disconnect the K482A Thermistor Mount from the power meter, and reconnect the R482A Thermistor Mount.
7. Press LEVEL and set for +1 dBm.
8. Press F1 and set for 26.500 GHz.
9. Verify that the power meter reads +1.0 dBm ±0.1 dB.
10. Press LEVEL and set for -9.0 dBm.
11. Verify that the power meter reads -9.0 dBm ±0.1 dB.

SECTION VI

PARTS LISTS

6-1 INTRODUCTION

This section provides parts lists for the multiband models of the WILTRON 6600A Programmable Sweep Generators. The parts lists are divided into three groups: major assembly parts, printed circuit board (PCB) parts, and options/accessories. Major assembly parts are illustrated in Figures 6-1 thru 6-9. PCB parts, including optional PCB's, are tabulated in Tables 6-1 thru 6-25. Options and accessories are listed in Table 6-26.

6-2 PARTS-ORDERING INFORMATION

Replaceable parts may be ordered either from the local WILTRON representative or directly from the factory.

WILTRON Company
825 East Middlefield Road
Mountain View, California 94043

Telephone: (415) 969-6500
TWX: 910-379-6578

When ordering, give complete information including the model and serial number of the instrument, the full part description, the WILTRON part number, and the quantity required.

6-3 ABBREVIATIONS

The following abbreviations appear in the "DESCRIPTION" column of the WILTRON parts lists:

CC — Carbon Composition
MF — Metal Film
WW — Wire-Wound

6-4 ORGANIZATION OF PARTS LISTINGS

The replaceable-parts lists are arranged under the following three categories:

Illustrated Major Assembly Parts Lists

Fig.	Major Assembly	Page
6-1	A0 Basic Frame Assy.	6-2
6-2	Top Assy.	6-4
6-3	A15 Front Panel Assy.	6-6
6-4	A16 Rear Panel Assy.	6-8
6-5	RF Deck Assy. – 6609A/6617A	6-10
6-6	RF Deck Assy. – 6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A	6-11
6-7	RF Deck Assy. – 6642A	6-12
6-8	RF Deck Assy. – 6653A/6659A	6-13
6-9	Oscillator Assy.	6-14

PCB Assembly Parts Lists

Table	PCB/PCB Assembly No.	Page
6-1	A1 GPIB Interface, Option 3 (660-D-8001)	6-16
6-2	A2 Ramp Generator (660-D-8002)	6-16
6-3	A3 Marker Generator (660-D-8003)	6-18
6-4	A4 ALC (660-D-8004)	6-20
6-5	A5 Frequency Instruction (660-D-8005)	6-22
6-6	A6 HET/YIG Driver, .01-2 GHz, 6609A (660-D-8007-4)	6-23
6-7	A6 HET/YIG Driver, 2-8 GHz, 6617A (660-D-8007-6)	6-25
6-8	A6 HET/YIG Driver, 2-8 GHz, 6621A/6637A/6638A/6647A/6648A (660-D-8007-3, -5, -99-91)	6-26
6-9	A6 YIG Driver, 2-8 GHz 6621A-40/6637A-40 (660-D-12868-3, -99-91)	6-28
6-10	A6 YIG Driver, 18-26.5 GHz, 6642A (660-D-8190-99-96)	6-29
6-11	A6 HET/YIG Driver, 2-8 GHz, 6653A/6659A (660-D-8007-7)	6-31
6-12	A6/A7/A8 YIG Driver, 8-12.4 GHz, 6621A/6629A/6637A/6638A/6647A/6648A (660-D-8009-4, -6, -7, -8, -99-90, -99-92)	6-32
6-13	A6/A7 YIG Driver, 8-12.4 GHz, 6621A-40/6629A-40/6637A-40 (660-D-8009-14, -17, -99-91, -99-93)	6-34
6-14	A6/A7/A8 YIG Driver, 12.4-18.6 GHz, 6629A-40/6637A-40 (660-D-8009-15, -16, -99-94)	6-35

Table	PCB/PCB Assembly No.	Page
6-15	A7/A8 YIG Driver, 12.4-18.6 (20) GHz 6629A/6637A/6638A/6647A/6648A (660-D-8008-4, -7, -99-90)	6-37
6-16	A7 YIG Driver 26.5-40 GHz, 6642A (660-D-8191-99-93)	6-38
6-17	A7 YIG Driver, 8-12.4 GHz, 6653A/6659A (660-D-8009-9, -12)	6-39
6-18	A8 YIG Driver, 12.4-18.6 GHz, 6653A/6659A (660-D-8009-10, -13)	6-41
6-19	A9 YIG Driver, 18-26.5 GHz, 6653A/6659A (660-D-8009-11)	6-42
6-20	A10 FM/Attenuator (660-D-8010)	6-43
6-21	A11 Front Panel (660-D-8011)	6-45
6-22	A12 Microprocessor (660-D-8012)	6-47
6-23	A13 Switching Power Supply (660-D-8013)	6-48
6-24	A14 Motherboard (660-D-8014)	6-50
6-25	A18 GPIB Connector (660-B-8018)	6-52

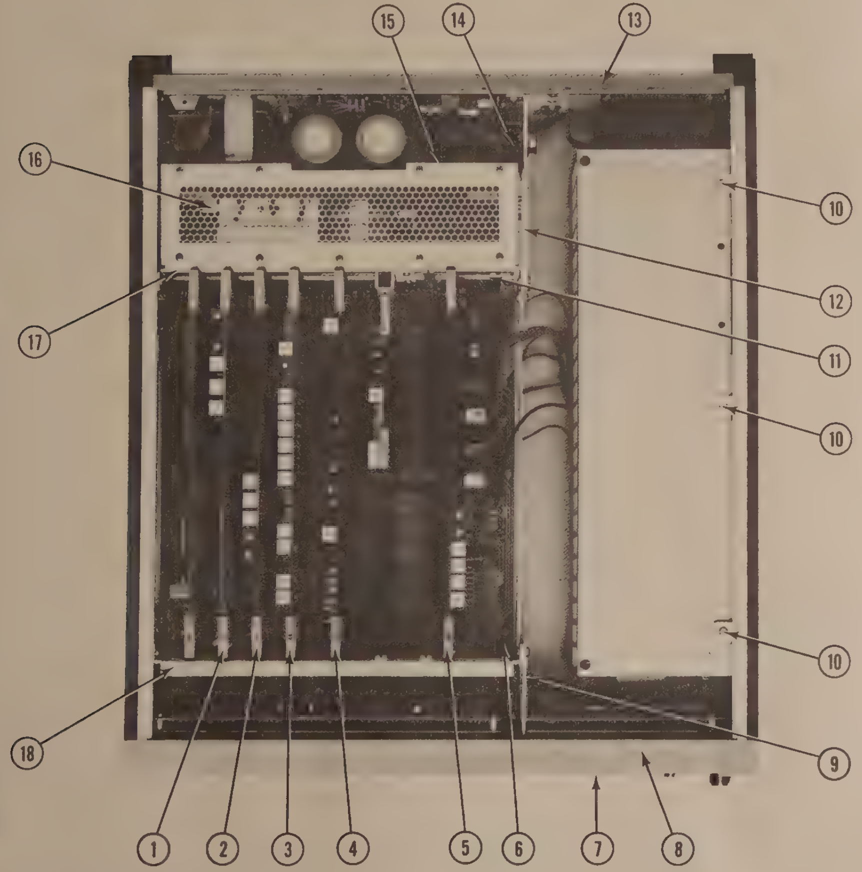
Options and Accessories Parts List

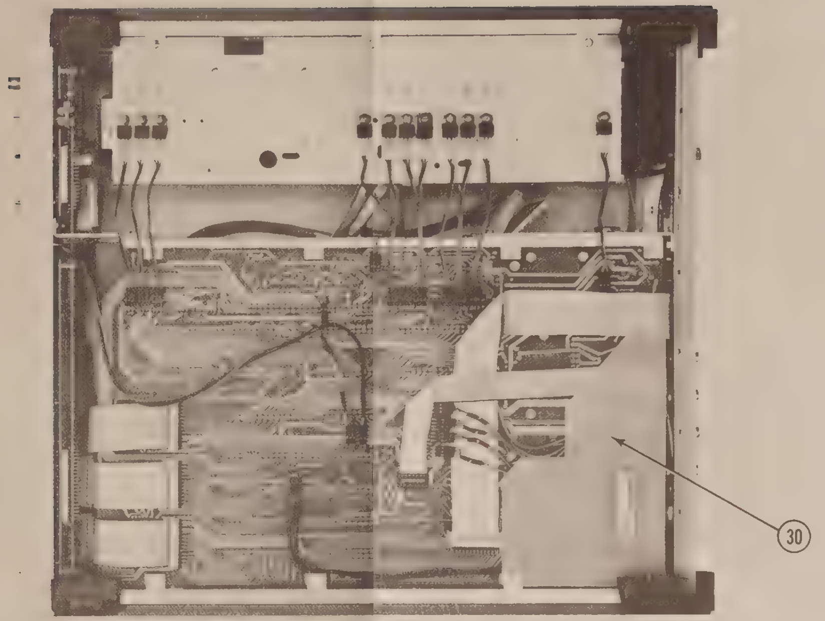
Table	Name	Page
6-26	Option 1, Rack Mount	6-53
6-26	Option 2, Step Attenuator	6-53
6-26	Option 3, GPIB Interface	6-53
6-26	Option 11, External Square-Wave Input, Standard (except 6642A)	6-53
6-26	Option 13, Counted Markers	
6-26	Accessories	6-53

INDEX NO.	NAME	PART NO.
1	A2 Ramp Generator PCB (Table 6-2)	660-D-8002
2	A3 Marker Generator PCB (Table 6-3)	660-D-8003
3	A4 Automatic Level Control (ALC) PCB (Table 6-4)	660-D-8004
4	A5 Frequency Instruction PCB (Table 6-5)	660-D-8005
5	A10 FM/Attenuator PCB (Table 6-20)	660-D-8010
6	A14 Motherboard PCB (Table 6-24)	660-D-8014
7	A15 Front Panel Assembly (Figure 6-3)	660-D-8015
8	Casting, Finished Front	660-D-8084
9	Bracket, Support, Front	660-B-8030
10	Clip, Mounting (heat sink & bracket for PCB and POWER switch support)	660-B-8031
11	Card Cage, Front	660-D-8069
12	Bracket, Support, Rear	660-B-8034
13	Casting, Finished Rear	660-D-8083
14	Cable Assembly (Regulator to Motherboard)	660-A-8033
15	Card Cage, Rear	660-D-8070
16	A13 Switching Power Supply PCB (Table 6-23)	660-D-8013
17	Bracket, PCB, Rear	660-B-8028
18	Bracket, PCB, Front	660-B-8027
19	A16 Rear Panel Assembly (Figure 6-4)	660-D-8016
20	Clip, Mounting (PCB)	660-B-8032
21	Plate, POWER Switch Mounting	560-A-7053
22	Extrusion, Corner Frame	660-B-8082
23	POWER Switch Extender Assembly	660-D-8025
24	Clip, Mounting, POWER Switch	560-B-7044
25	Plate, POWER Switch Support	660-A-8099
26	Guide, PCB	553-97
27	Guide, PCB	553-41
–	Heat Sink	553-65
28	Guide, PCB	660-A-8035
29	Card Cage, Top	660-B-8068

Figure 6-1. A0 Basic Frame Assembly (Sheet 1 of 2)

INDEX NO.	NAME	PART NO.
30	Shield, Voltage Protection	660-B-8072
–	Angle Support, PCB	660-B-8029
–	Regulator, +15V, 7815	54-MC7815CP
–	Regulator, -15V, 7915	54-MC7915CP
–	Regulator, -15V, μA79HGKC	54-145
–	Insulator, Mica	790-70
–	Clamp, Cable	720-3/16
–	Washer, Shoulder	790-52


15
14
13
16
10
12
17
11
10
18
10
9
1
2
3
4
5
6
7
8



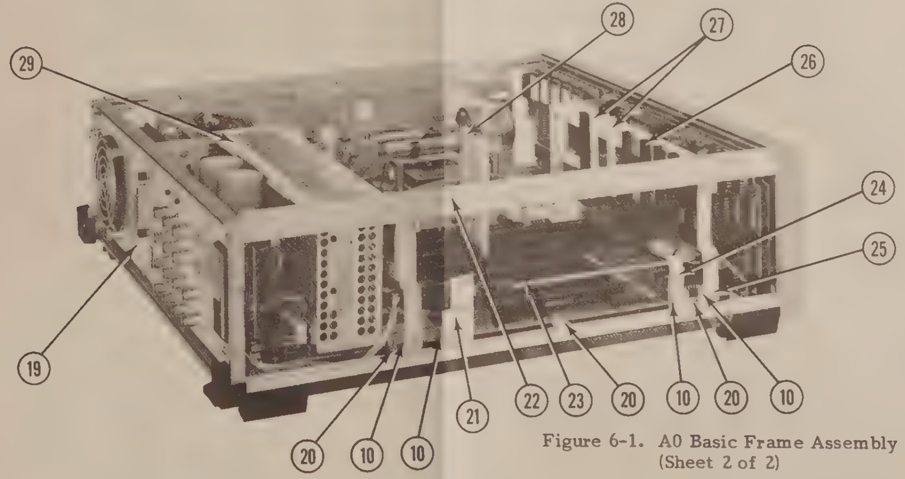
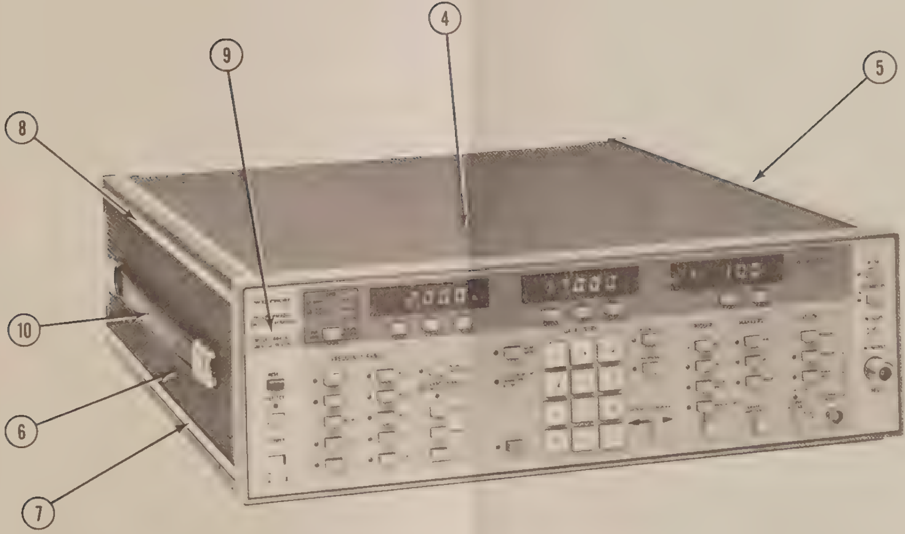

28
27
26
29
24
25
19
21
22
23
20
10
20
10
20
10
10

Figure 6-1. A0 Basic Frame Assembly (Sheet 2 of 2)


4
9
5
8
10
6
7

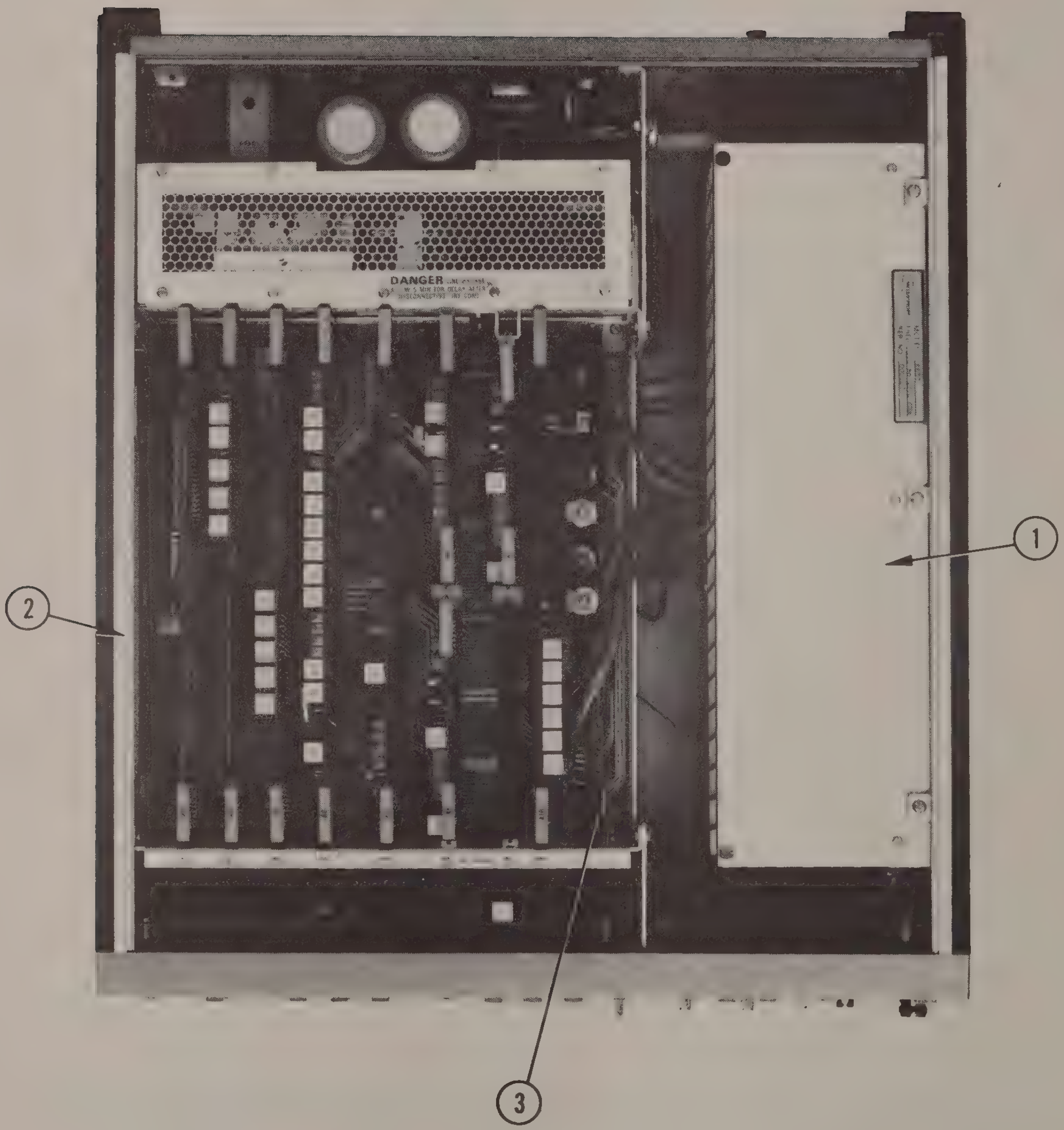


Figure 6-2. Top Assembly (Sheet 1 of 2)

Reference Photo

INDEX NO.	NAME	PART NO.
1	RF Deck Assembly (Figure 6-5 thru 6-8)	
	a. 6609A	660-D-8050
	b. 6617A	660-D-8057-1
	c. 6621A	SPCL-D-11550
	d. 6621A-40	SPCL-D-13065
	e. 6629A	SPCL-D-11585
	f. 6629A-40	SPCL-D-13079
	g. 6637A	660-D-8053-1
	h. 6637A-40	660-D-12871-1
	i. 6638A	660-D-8058-1
	j. 6642A	SPCL-D-11620
	k. 6647A	660-D-8054-1
	l. 6648A	660-D-8055-1
	m. 6653A	660-D-12608-1
	n. 6659A	660-D-12609-1
2	Basic Frame Assembly (Figure 6-1)	660-D-8000
3	Connector Jumper Assembly	660-A-8144
4	Covers, Top and Bottom	660-D-8044
5	Cover, Right Side	660-D-8045
6	Cover, Left Side	660-D-8046
7	Trim Strip, Bottom	560-B-7036
8	Trim Strip, Top	560-B-7037
9	Model Number Nameplate	
	a. 6609A	660-B-8093-3
	b. 6617A	660-B-8093-7
	c. 6621A	SPCL-A-11554
	d. 6621A-40	SPCL-A-13076
	e. 6629A	SPCL-A-11589
	f. 6629A-40	SPCL-A-13083
	g. 6637A	660-B-8093-2
	h. 6637A-40	660-B-8093-11
	i. 6638A	660-B-8093-8
	j. 6642A	SPCL-A-11625
	k. 6647A	660-B-8093-1
	l. 6648A	660-B-8093-9
	m. 6653A	660-B-8093-12
	n. 6659A	660-B-8093-10
10	Handle Assembly	
	Strap	783-100
	Cap	783-11
	Bracket	783-12
–	Coupler Assembly (No RF OUTPUT Options)	
	a. 6609A	660-B-8125-1
	b. 6638A/6648A	660-B-8125-4
	c. All others	660-B-8125-2
–	Tilt Bail	2000-61F
–	Foot, Bottom	2000-61G
–	Foot, Rear	2000-61H
–	Fuse, Line (2A SB, 3AG)	631-16
–	Cord, Line	800-119
–	Rubber Pad	2000-61K

Figure 6-2. Top Assembly (Sheet 2 of 2)

INDEX NO.	NAME	PART NO.
1	Potentiometer Assembly, EXTERNAL ALC GAIN	660-A-8024
2	Cable Assembly (EXTERNAL INPUT to A14P37)	660-A-8023
3	A12 Microprocessor PCB (Table 6-22)	660-D-8012
4	A11 Front Panel PCB (Table 6-21)	660-D-8011
5	Switch Assembly, INCREASE/ DECREASE	660-B-8017
6	Subpanel	660-D-8042
7	Button, RESET	SPEC-C-8187-3
8	Button, Grey (40 ea.)	SPEC-C-8187-1
9	Button, SHIFT	SPEC-C-8187-4
10	Buttons, Keypad	
	a. "1"	660-A-8073-1
	b. "2"	660-A-8073-2
	c. "3"	660-A-8073-3
	d. "4"	660-A-8073-4
	e. "5"	660-A-8073-5
	f. "6"	660-A-8073-6
	g. "7"	660-A-8073-7
	h. "8"	660-A-8073-8
	i. "9"	660-A-8073-9
	j. "0"	660-A-8073-10
	k. "."	660-A-8073-11
	l. "-"	660-A-8073-12
–	Knob (MANUAL SWEEP and MARKER AMPLITUDE)	61084-A-5452
–	Insert	A710-56
–	Knob, Push to Check (EXTERNAL ALC GAIN)	660-A-8064
–	Insert	710-56
–	Front Panel (Plastic)	660-D-8043
–	Connector, BNC, Insulated (EXTERNAL INPUT)	510-31
–	Connector Housing, 2-pin	551-230
–	Female Pins	551-154
–	Connector, Insulated Displacement for RG 174	551-233
–	Knob Retainer	710-56
–	Cable, Coax	800-5

Figure 6-3. A15 Front Panel Assembly (Sheet 1 of 2)

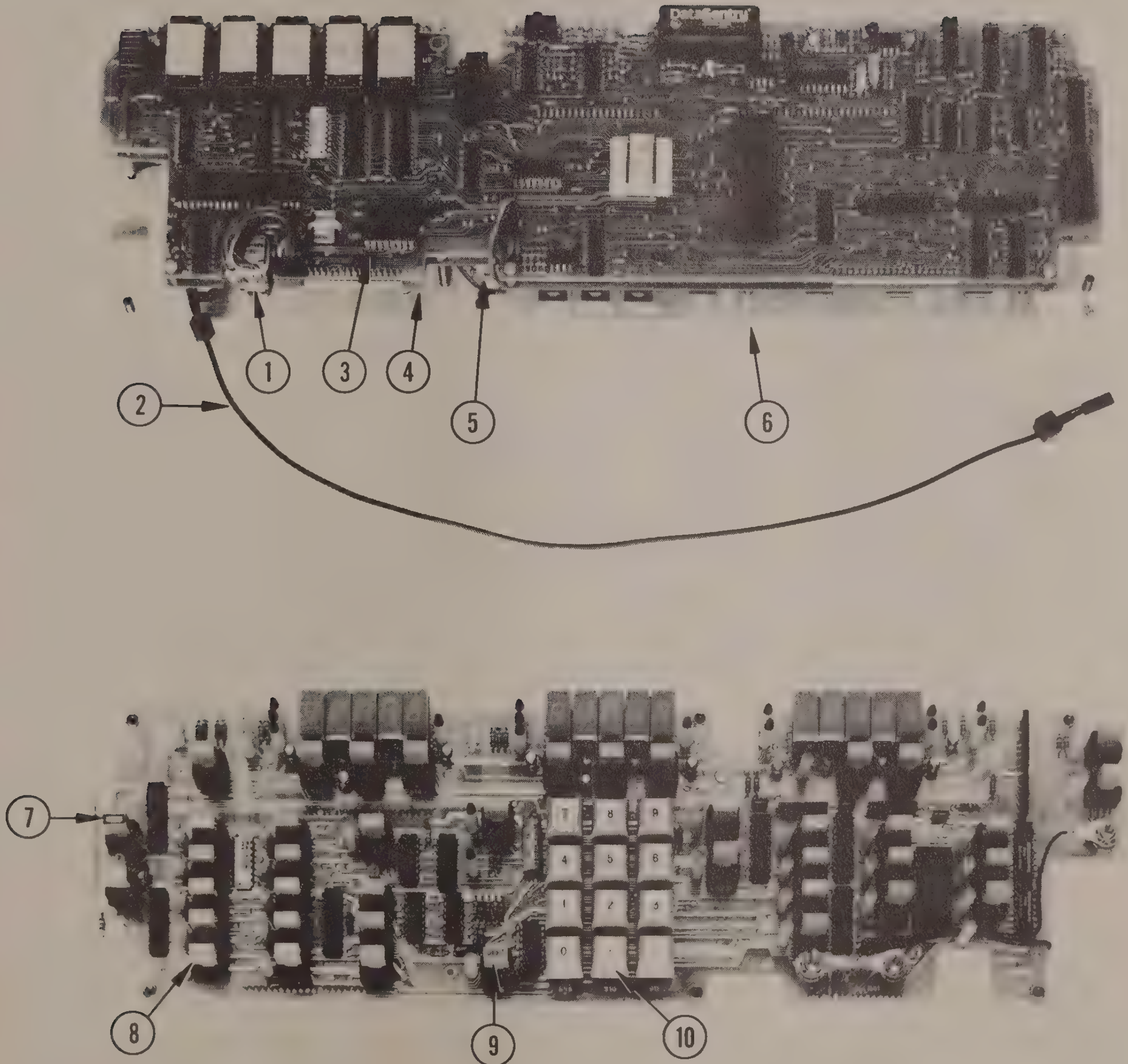

1
3
4
2
5
6
7
8
9
10

Figure 6-3. A15 Front Panel Assembly (Sheet 2 of 2)

INDEX NO.	NAME	PART NO.
1	Shield, Fan	660-B-8142
2	Fan	650-4
3	Plug, Button, 5/8	790-42
4	Plug, Button, 1/4	790-146
5	Cover, GPIB (In place of cover, A18 GPIB Connector PCB (Table 6-25) is shown installed.)	560-A-7041
6	(Not shown) 25-pin Connector Housing #553-294; Receptacle, #553-89	660-A-12700
7	Switch, DPDT	430-49
8	Connector, BNC	510-5
9	Connector, BNC, Insulated	510-31
10	Plug, Button, 3/8	790-41
11	Transformer	320-58
12	Voltage Selector Module	551-142
	Female Pins, 14 ea.	551-155
13	Panel	660-D-8026
14	Connector Housing, 10-Pin	551-199
	Female Pins (Pins 1 & 3-10)	551-35
	Female Pin (Pin 2)	551-200
15	Switch, POWER	430-139
–	Connector Housing, 4-Pin	551-229
–	Connector Housing, 2-Pin	551-230
	Female Pins, 6 ea.	551-154
–	Connector Insulation (Displacement for RG 174)	551-233
–	Filter, Air	783-116
–	Finger Guard	790-142
–	Thumb Nut	790-143
–	Cable, Shielded Pair	800-28
–	Cable, Coax, RG174	800-5
–	Cable Assembly, Flat (between A14X16 and BNC connectors)	802-16A-23.4
–	Connector Housing, 3-Pin	551-202
	Receptacle	551-250
–	Capacitor, .0047 μF, 3 kV	250-97

Figure 6-4. A16 Rear Panel Assembly (Sheet 1 of 2)

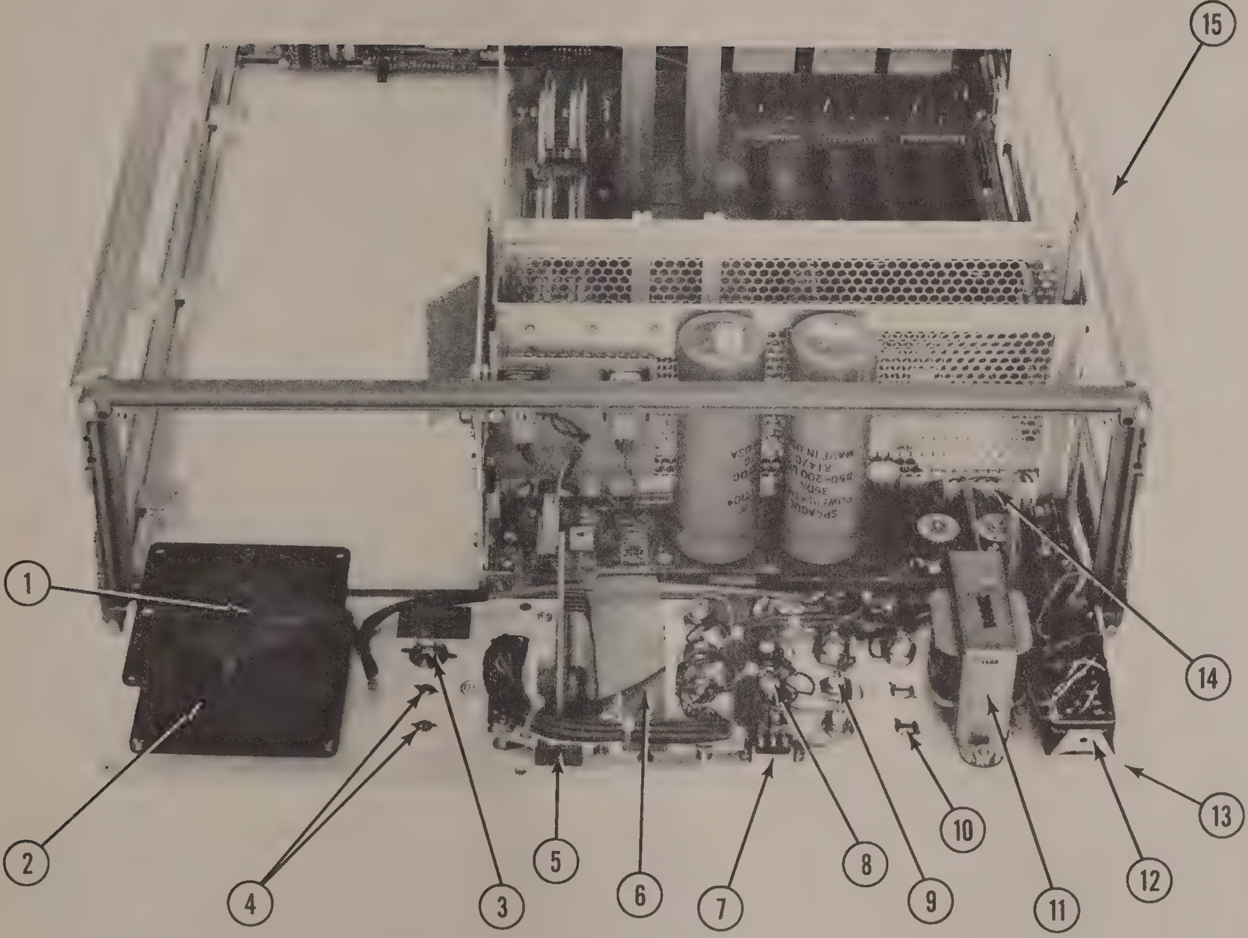

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Figure 6-4. A16 Rear Panel Assembly (Sheet 2 of 2)

INDEX NO.	NAME	PART NO.
1	YIG Oscillator Assembly (Figure 6-9)	
	a. 4.6-6.6 GHz (6609A)	660-C-8192
	b. 2-8 GHz (6617A)	660-C-8087-2
2	Matched Modulator Assembly	660-B-9342
3	Filter	Figure 6-9
4	Cable Clip	721-17
5	Down Converter Assembly (6617A)	MEF-D-9157
6	DPDT Switch	660-B-8149
7	Transformer Assembly	
	a. 6609A	320-65
	b. 6617A	320-66

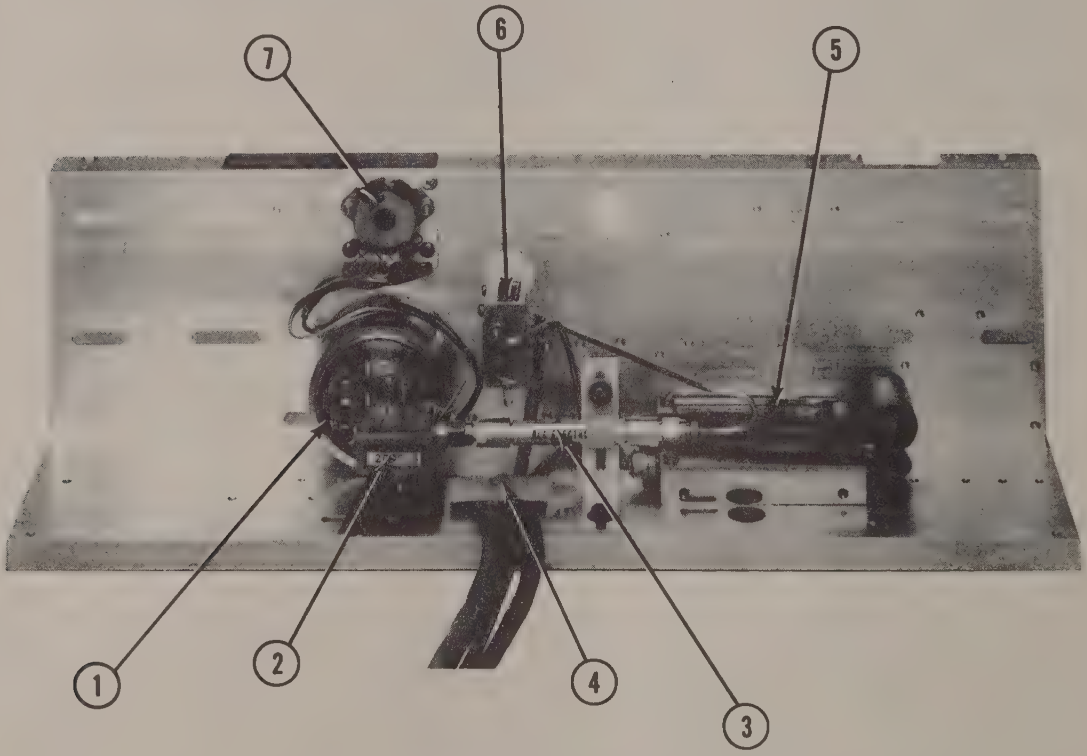


Figure 6-5. RF Deck Assembly - 6609A/6617A

INDEX NO.	NAME	PART NO.
1	Oscillator Assembly, 12.4-18.6 (or 20) GHz	Figure 6-9
	a. 6629A/6637A/6647A	660-C-8085-1
	b. 6629A-40/6637A-40	
	(1) Avantek Osc. & Amplica Amp.	660-C-12872-2
	(2) Avantek Osc. & Litton Amp.	660-C-12872-1
	(3) WJ Osc. & Amplica Amp.	660-C-12872-4
	(4) WJ Osc. & Litton Amp.	660-C-12872-3
2	Isolator	Figure 6-9
3	Filter	Figure 6-9
4	Transformer, Compensation	
	a. YIG Osc. P/N 1005-46 or 47	320-66
	b. YIG Osc. P/N 1005-53 or 54	320-65
	c. YIG Osc. P/N 1005-51, -52, -59	320-64
5	Oscillator Assembly, 2-8 GHz (Figure 6-9)	
	a. 6621A/6637A/6638A/6647A/6648A	660-C-8087-1
	b. 6621A-40/6637A-40	
	(1) Amplica Amp.	660-C-12874-2
	(2) Litton Amp.	660-C-12874-1
6	Matched Modulator	660-B-9342
7	Cable Clip	721-17
8	Filter	Figure 6-9
9	Cable Coax, Filter to PIN Switch	660-A-8102-6
10	Down Converter Assembly	MEF-D-9157
11	Isolator	Figure 6-9
12	Oscillator Assembly, 8-12.4 GHz (Figure 6-9)	
	a. 6621A/6629A/6637A/6647A	
	(1) Avantek Osc.	660-C-8086-2
	(2) WJ Osc.	660-C-8086-3
	b. 6638A/6648A	
	(1) Avantek Osc.	660-C-8086-5
	(2) WJ Osc.	660-C-8086-4
	c. 6621A-40/6637A-40	
	(1) Avantek Osc. & Amplica Amp.	660-C-12873-2
	(2) Avantek Osc. & Litton Amp.	660-C-12873-1
	(3) WJ Osc. & Amplica Amp.	660-C-12873-4
	(4) WJ Osc. & Litton Amp.	660-C-12873-3
13	Cable Assembly, Isolator to Filter	660-A-8102-6
14	Filter	Figure 6-9
15	PIN Switch Assembly	660-D-8821
–	Voltage Regulator, -5V	54-184
–	10 dB Pad	1010-28

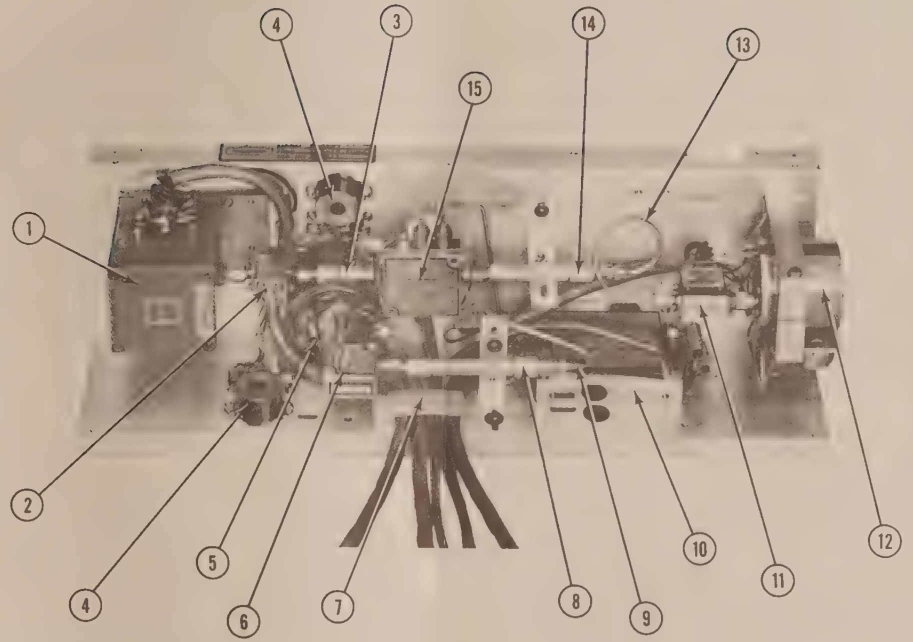


Figure 6-6. RF Deck Assembly - 6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A

INDEX NO.	NAME	PART NO.
1	YIG Oscillator Assembly, 13.25-20 GHz (Figure 6-9)	SPCL-C-11622
2	Compensation Transformer	320-64
3	Isolator	Figure 6-9
4	PIN Modulator	1020-17
5	Cable Assembly, PIN Mod. to Doubler	660-A-8103-3
6	YIG Oscillator Assembly, 18-26.5 GHz (Figure 6-9)	SPCL-C-11621
7	Cable Assembly, PIN Mod. to Coupler	660-A-8103-5
–	Housing, 10-pin	551-199
–	PIN Modulator Cable Assembly	SPEC-S-6494
–	Cable Clip	721-17
–	Waveguide Assembly	660-A-8166
–	Frequency Doubler	1040-13
–	WSMA Output Assembly	660-D-9371
–	Detector, Model 70	70-A-7453
–	Thermistor	35-4
–	Feed-Thru	702-2
–	Coupler, 18-26.5 GHz	1091-21
–	Coupler Cable Assembly	660-A-9378
–	(VR1) IC, -5V Regulator, µA7905	54-185
–	Nylon Clamp, 1/2"	720-1/2
–	RF Deck Extrusion	660-D-8115
–	Standoff, 4-40 x 1.75"	785-420
–	Base Plate	790-163
–	Washer	790-164
–	Clamp	790-165
–	(T1) Compensation Transformer	320-64

Figure 6-7. RF Deck Assembly - 6642A

Reference Photo

INDEX NO.	NAME	PART NO.
1	Oscillator Assembly, 18-26.5 GHz (Figure 6-9)	660-C-8175-2
2	Isolator	Figure 6-9
3	Down Converter Assembly (6659A)	MEF-D-9157
4	Cable Assembly, Down Converter to PIN Switch J1	CABL-A-9202-24
5	10 dB Pad	1010-28
6	PIN Switch Assembly	660-D-11745-2
7	Cable Assembly, 10 dB Pad to PIN Switch J6	CABL-A-9202-23
8	Oscillator Assembly, 12.4-18 GHz (Figure 6-9)	
	a. Avantek Oscillator	660-C-8085-2
	b. WJ Oscillator	660-C-8085-3
9	Filter	Figure 6-9
10	Cable Assembly, Filter to PIN Switch J2	CABL-A-9203-6
11	Cable Assembly	
	a. Avantek Oscillator to Filter	CABL-A-9201-22
	b. WJ Oscillator to Isolator	CABL-A-9204-5
12	Cable Clip	721-17
13	Matched Modulator Assembly	660-B-9342
14	Oscillator Assembly, 2-8 GHz (Figure 6-9)	660-C-8087-4
15	Transformer, Compensation	
	a. YIG Oscillator 1005-46 or -47	320-66
	b. YIG Oscillator 1005-53 or -54	320-65
	c. YIG Oscillator 1005-55, -59, or -61	320-64
16	Oscillator Assembly, 8-12.4 GHz (Figure 6-9)	
	a. Avantek Oscillator	660-C-8086-6
	b. WJ Oscillator	660-C-8086-7
17	Cable Assembly, Filter to PIN Switch J3	CABL-A-9202-22
–	Transistor, PNP, TIP 117	20-5
–	Voltage Regulator, -5V	54-184

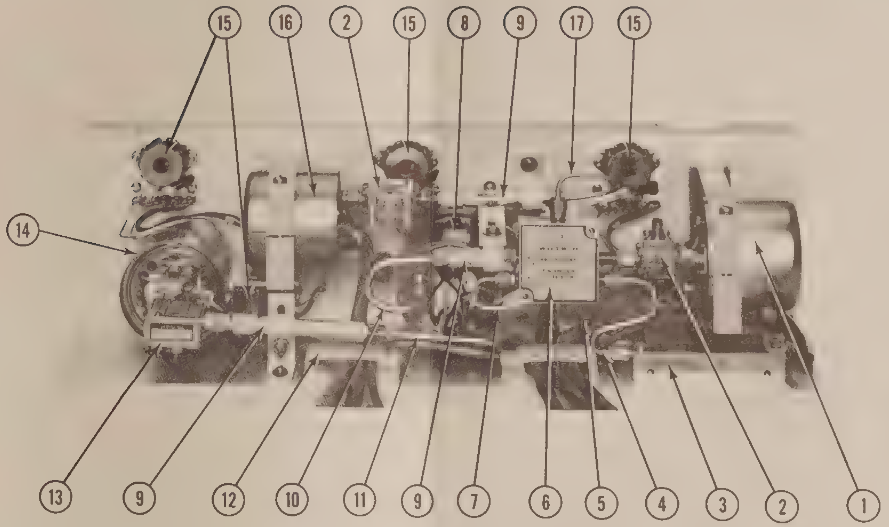


Figure 6-8. RF Deck Assembly - 6653A/6659A

INDEX NO.	NAME	PART NO.
1	PCB Assembly, YIG Driver	
	a. 2-8 GHz (6609A, Table 6-6)	660-D-8007-4
	b. 2-8 GHz (6617A, Table 6-7)	660-D-8007-6
	c. 2-8 GHz (6621A, Table 6-8)	660-D-8007-99-91
	d. 2-8 GHz (6637A/6647A, Table 6-8)	660-D-8007-3
	e. 2-8 GHz (6621A-40, Table 6-9)	660-D-12868-99-91
	f. 2-8 GHz (6637A-40, Table 6-9)	660-D-12868-3
	g. 2-8 GHz (6638A/6648A, Table 6-8)	660-D-8007-5
	h. 2-8 GHz (6653A/6659A Table 6-11)	660-D-8007-7
	i. 8-12.4 GHz	
	(1) Avantek (6621A, Table 6-12)	660-D-8009-99-90
	(2) Avantek (6621A-40, Table 6-13)	660-D-8009-99-91
	(3) Avantek (6629A, Table 6-12)	660-D-8009-99-92
	(4) Avantek (6629A-40, Table 6-13)	660-D-8009-99-93
	(5) Avantek (6637A/6647A, Table 6-12)	660-D-8009-4
	(6) Avantek (6637A-40, Table 6-13)	660-D-8009-14
	(7) Avantek (6638A/6648A, Table 6-12)	660-D-8009-6
	(8) Avantek (6653A/6659A, Table 6-17)	660-D-8009-9
	(9) WJ (6637A/6647A, Table 6-12)	660-D-8009-7
	(10) WJ (6637A-40, Table 6-13)	660-D-8009-17
	(11) WJ (6638A/6648A, Table 6-12)	660-D-8009-8
	(12) WJ (6653A/6659A, Table 6-17)	660-D-8009-12
	j. 12.4-18.6 GHz	
	(1) Avantek (6629A-40, Table 6-14)	660-D-8009-99-94
	(2) Avantek (6637A-40, Table 6-14)	660-D-8009-16
	(3) Avantek (6653A/6659A, Table 6-18)	660-D-8009-10
	(4) WJ (6629A, Table 6-15)	660-D-8008-99-90
	(5) WJ (6637A/6647A, Table 6-15)	660-D-8008-4
	(6) WJ (6637A-40, Table 6-14)	660-D-8009-15
	(7) WJ (6653A/6659A, Table 6-18)	660-D-8009-13
	k. 12.4-20 GHz (6638A/6648A, Table 6-15)	660-D-8008-7
	l. 18.6-26.5 GHz (6653A/6659A, Table 6-19)	660-D-8009-11
	m. 18.6-26.5 GHz (6642A, Table 6-10)	660-D-8190-99-98
	n. 26.5-40 GHz (6642A, Table 6-16)	660-D-8191-99-93
2	Cable, Transistor (3 ea)	660-A-8100
3	Transistors Q1, Q2, Q3;	20-2N6044
	Q1 on 6609A/6617A; .01-18 GHz band of 6637A/6637A-40/6647A/6653A and 6659A; and 8-12.4 GHz band of 6637A/6637A-40/6638A/6647A/6648A	20-2N6041
4	Cable, SMA Male-Male, RG085	660-A-8101-5

Figure 6-9. Oscillator Assembly (Sheet 1 of 2)

Reference Photo

INDEX NO.	NAME	PART NO.
–	YIG Oscillator, 4.6-6.6 GHz (6609A)	
	a. Avantek	1005-45
	b. WILTRON	1005-C-11236
5	YIG Oscillator, 2-8 GHz (All except 6609A/6642A)	1005-46 or -47
6	YIG Oscillator, WJ	
	a. 8-12.4 GHz (6637A/6637A-40/6638A/6647A/6648A/6653A/6659A)	1005-54
	b. 12.4-18.6 GHz (6629A/6637A/6637A-40/6647A/6653A/6659A	1005-51
	c. 12.4-18.0 GHz (6653A/6659A)	1005-55
	d. 12.4-20 GHz (6638A/6648A)	1005-52
	e. 13.25-20 GHz (6642A)	1005-40
7	YIG Oscillator, Avantek	
	a. 8-12.4 GHz (6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A)	1005-53
	b. 12.4-18.6 GHz (6629A-40/6637A-40/6653A/6659A)	1005-59
	c. 18-26.5 GHz (6642A)	1005-61
8	Isolator	
	a. 4-8 GHz (6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A/6653A/6659A)	1000-29
	b. 7-12.4 GHz (6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A/6653A/6659A)	1000-21
	c. 12.4-18.6 GHz (6629A/6629A-40/6637A/6637A-40/6647A/6653A/6659A)	1000-20
	d. 12.4-20 GHz (6638A/6648A)	1000-35
9	Low-Pass Filter	
	a. 2-8 GHz (All except 6609A/6642A)	1030-26
	b. 8-12.4 GHz (6621A/6621A-40/6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A/6653A/6659A)	1030-29
	c. 2-18.7 GHz (6629A/6629A-40/6637A/6637A-40/6638A/6647A/6648A/6653A/6659A)	1030-31
	d. 12.4-20 GHz (6638A/6648A)	1030-32
10	Capacitor, Tantalum, 10 µF, 25V	250-42
11	Capacitor	
	a. 8-12.4 GHz Oscillator on 6653A/6659A: 15 µF	250-25
	b. 8-12.4 GHz Oscillator on all others: 10 µF	250-42A
	c. 12.4-18 GHz Oscillator on 6653A/6659A: 10 µF	250-42
	d. 12.4-18 GHz Oscillator on all others: 100 µF	250-50
12	Capacitor, Tantalum, 10 µF	250-42
13	Core, Torroid	640-5
14	Connector Housing, 16-pin	551-247
	Female Pin	551-35
–	Resistor (R1) MF, 1/4W, 1%, 11Ω	110-11-1
–	Cover (for Item 6 oscillator)	660-B-8160

Figure 6-9. Oscillator Assembly (Sheet 2 of 2)

Table 6-1. A1 GPIB Interface, Option 3 (660-D-8001)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 2.2 µF, 20V	250-40A
C2	Tantalum, 2.2 µF, 20V	250-40A
C3	Tantalum, 10 µF, 25V	250-42
C4	Monolithic, .1 µF, 50V	230-37
C5	Monolithic, .1 µF, 50V	230-37
C6	Monolithic, .1 µF, 50V	230-37
C7	Monolithic, .1 µF, 50V	230-37
C8	Monolithic, .1 µF, 50V	230-37
C9	Monolithic, .1 µF, 50V	230-37

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 5.11k	110-5.11k-1
R2	MF, 1/4W, 1%, 10k	110-10k-1
R3	MF, 1/4W, 1%, 10k	110-10k-1
R4	MF, 1/4W, 1%, 10k	110-10k-1
R5	MF, 1/4W, 1%, 10k	110-10k-1
R6	MF, 1/4W, 1%, 40.2k	110-40.2k-1
R7	MF, 1/4W, 1%, 487Ω	110-487-1
R8	MF, 1/4W, 1%, 40.2k	110-40.2k-1
R9	MF, 1/4W, 1%, 10k	110-10k-1
RP1	Resistor Network, 10k, 8-Pin, 7-Resistor	123-6
RP2	Resistor Network, 10k, 8-Pin, 7-Resistor	123-6

INTEGRATED CIRCUITS, SOCKETS, AND PLUGS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	8255A, Programmable Interface	54-155
U2	PD211ALC-4 256 x 4 Static RAM	54-11
U3	PD211ALC-4 256 x 4 Static RAM	54-11
U5	2716 2k x 8 EPROM	Contact WILTRON Customer Service
U6	74LS155, Dual 1-of-4 Decoder	54-101
U7	74LS138, 1-of-8 Decoder	54-74LS138
U8	74LS373, Octal Latch	54-103
U9	Not Used	
U10	74LS04, Hex Inverter	54-74LS04
U11	74LS01, Quad Open Collector NAND	54-74LS01
U12	8085A, CPU	54-93
U13	74LS123 one shot	54-116
U14	7474, Dual D Flip-Flop	54-7474
U15	74LS244, Non-inverting Octal Tri-State Driver	54-143
U16	74LS244, Non-inverting Octal Tri-State Driver	54-143
U17	8291 GPIB Listener/Talker	54-124
U18	MC3447 Motorola GPIB Transreceiver, ceramic pkg., Cs. 623	54-142
U19	MC3447 Motorola GPIB Transreceiver, ceramic pkg., Cs. 623	54-142
U20	74LS74, Dual D Flip-Flop	54-44
U21	74LS74, Dual D Flip-Flop	54-44
U22	74LS374, Octal Latch	54-41
U23	74LS112, Dual J-K Flip-Flop	54-74LS112
U24	74LS374, Octal Latch	54-41
U25	74LS00, Quad NAND	54-74LS00
---	Socket, Dip, 18-Pin; U9	551-148
---	Socket, Dip, 40-Pin; U1, 12, 17	553-66
---	Socket, Dip, 24-Pin; U4, 5	553-67
---	Plug, Dip, 18-Pin; U9	551-236

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	Transistor, 2N4249, PNP	20-2N4249
S1	Switch, Slide, SPDT	420-14
TP1 thru TP22	Test Point Pins	706-44
Y1	Crystal, 6.000 MHz	630-17
---	Ejector, P.C. Board	553-96

Table 6-2. A2 Ramp Generator (660-D-8002)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 6V, 68 µF	250-58
C2	Monolithic, 50V, .1 µF	230-37
C3	Monolithic, 50V, .1 µF	230-37
C4	Monolithic, 50V, .1 µF	230-37
C5	Monolithic, 50V, .1 µF	230-37
C6	Monolithic, 50V, .1 µF	230-37
C7	Monolithic, 50V, .1 µF	230-37
C8	Monolithic, 50V, .1 µF	230-37
C9	Monolithic, 50V, .1 µF	230-37
C10	Mica, 250V, 270 pF	223-270
C11	Monolithic, 50V, .01 µF	250-77
C12	Monolithic, 50V, .01 µF	250-77
C13	Monolithic, 50V, .1 µF	230-37
C14	Monolithic, 50V, .1 µF	230-37
C15	Monolithic, 50V, .1 µF	230-37
C16	Monolithic, 50V, .1 µF	230-37
C17	Monolithic, 50V, .1 µF	230-37
C18	Monolithic, 50V, .1 µF	230-37
C19	Monolithic, 50V, .1 µF	230-37
C20	Monolithic, 50V, .1 µF	230-37
C21	Monolithic, 50V, .1 µF	230-37
C22	Monolithic, 50V, .1 µF	230-37
C23	Mylar, 250V, 1 µF	210-36
C24	Tantalum, 25V, 10 µF	250-42
C25	Tantalum, 25V, 10 µF	250-42
C26	Monolithic, 50V, .1 µF	230-37
C27	Mylar, 250V, .47 µF	210-28

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Reference, 1N823, 6.2V, 0.4W	10-1N823
CR3	Silicon, 1N4446	10-1N4446
CR4	Zener, 1N751A, 5.1V, 0.4W	10-1N751A
CR5	Silicon, 1N4446	10-1N4446
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 1N751A, 5.1V, 0.4W	10-1N751A
CR10	Hot-carrier, MBD-501	10-4
CR11	Zener, 1N758A, 10V, 0.4W	10-1N758A
CR12	Silicon, 1N4446	10-1N4446
CR13	Zener, 1N751A, 5.1V, 0.4W	10-1N751A
CR14	Zener, 1N746A, 3.3V, 0.4W	10-1N746A
CR15	Zener, 1N751A, 5.1V, 0.4W	10-1N751A
CR16	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	2N3694, PNP, 0.2W	20-2N3694
Q2	2N4249, NPN, 0.4W	20-2N4249
Q3	2N3694, PNP, 0.2W	20-2N3694
Q4	2N3694, PNP, 0.2W	20-2N3694
Q5	2N3694, PNP, 0.2W	20-2N3694
Q6	2N4249, NPN, 0.4W	20-2N4249
Q7	2N3694, PNP, 0.2W	20-2N3694
Q8	J112, JFET	20-17
Q9	J112, JFET	20-17
Q10	2N3694, PNP, 0.2W	20-2N3694
Q11	2N4249, NPN, 0.4W	20-2N4249
Q12	2N3694, PNP, 0.2W	20-2N3694
Q13	2N4249, NPN, 0.4W	20-2N4249

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 1.15 kΩ	110-1.15k-1
R2	MF, 1/4W, 1%, 17.4 kΩ	110-17.4k-1
R3	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R4	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R5	MF, 1/4W, 1%, 56.2Ω	110-56.2-1
R6	Variable, 1/2W, 10%, 200 kΩ	156-200k
R7	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R8	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R9	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R10	Variable, 1/2W, 10%, 10 kΩ	156-10k
R11	MF, 1/4W, 1%, 10.2 kΩ	110-10.2k-1
R12	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R13	MF, 1/4W, 1%, 1.07 kΩ	110-1.07k-1
R14	MF, 1/4W, 1%, 19.6 kΩ	110-19.6k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 392 kΩ	110-392k-1
R17	Variable, 1/2W, 10%, 500 kΩ	156-500k
R18	MF, 1/4W, 1%, 3.48 kΩ	110-3.48k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 100Ω	110-100-1
R21	MF, 1/4W, 1%, 2.43 kΩ	110-2.43k-1
R22	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R23	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R24	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R25	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R26	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R27	MF, 1/4W, 1%, 511Ω	110-511-1
R28	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R29	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R30	MF, 1/4W, 1%, 1.1 kΩ	110-1.1k-1
R31	Variable, 1/2W, 10%, 2 kΩ	156-2k
R32	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R33	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R34	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R35	MF, 1/4W, 1%, 100Ω	110-100-1
R36	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R37	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R38	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R39	Variable, 1/2W, 10%, 1 kΩ	156-1k
R40	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R41	CC, 1/4W, 5%, 2.2 MΩ	101-2.2M-5
R42	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R43	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R44	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R47	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R48	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R49	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R50	MF, 1/4W, 1%, 140 kΩ	110-140k-1
R51	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R52	MF, 1/4W, 1%, 511Ω	110-511-1
R53	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R56	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R57	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R58	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R59	MF, 1/4W, 1%, 34 kΩ	110-34k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	MF, 1/4W, 1%, 3.48 kΩ	110-3.48k-1
R62	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R65	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R66	MF, 1/4W, 1%, 140 kΩ	110-140k-1
R67	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R68	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R69	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 3.48 kΩ	110-3.48k-1
R72	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	CC, 1/4W, 5%, 1.2 MΩ	101-1.2M-5
R76	Variable, 1/2W, 10%, 1 MΩ	156-1M
R77	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R78	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Dual D Flip-Flop, 74LS74	54-44
U2	Quad AND, 74LS08	54-74LS08
U3	Timer, NE-555	54-555
U4	Counter, 74LS161	54-60
U5	Hex Inverter, 74LS04	54-74LS04
U6	Decoder, 74LS138	54-74LS138
U7	Octal Latch, 74LS374	54-41
U8	2-1 Multiplexer, 74LS157	54-59
U9	4-Bit Counter, 74LS191	54-120
U10	Quad Inverter, 74LS05	54-105

U11	Dual D Flip-Flop, 74LS74	54-44
U12	2-1 Multiplexer, 74LS157	54-59
U13	4-Bit Counter, 74LS191	54-120
U14	Octal Latch, 74LS374	54-41
U15	8-Bit Latch/DAC, AD7524	54-129
U16	Dual D Flip-Flop, 74LS74	54-44
U17	Quad NAND Gate, 74LS00	54-74LS00
U18	Dual Op-Amp, TL072	54-53
U19	Data Selector, 74LS151	54-119
U20	Dual Op-Amp, TL072	54-53
U21	Quad Switch, DG201	54-24
U22	Dual D Flip-Flop, 74LS74	54-44
U23	4-Input NAND, 74LS20	54-74LS20
U24	Dual D Flip-Flop, 74LS74	54-44
U25	QUAD Comparator, LM339	54-45
U26	Quad NAND, 74LS01	54-74LS01
U27	Quad NOR, 74LS02	54-57
U28	Dual Switch, DG200	50-DG200BA

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
K1	Relay	690-28
S1	Slide Switch	420-14
TP1 thru TP7	Test Points	706-44
——	Ejector, P.C. Board	553-96

Table 6-3. A3 Marker Generator (660-D-8003)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 68 µF, 6V	250-58
C2	Monolithic, .1 µF, 50V	230-37
C3	Monolithic, .1 µF, 50V	230-37
C4	Monolithic, .1 µF, 50V	230-37
C5	Not Used	
C6	Not Used	
C7	Tantalum, 10 µF, 25V	250-42
C8	Tantalum, 10 µF, 25V	250-42
C9	Monolithic, .1 µF, 50V	230-37
C10	Monolithic, .1 µF, 50V	230-37
C11	Tantalum, 10 µF, 25V	250-42
C12	Monolithic, .1 µF, 50V	230-37
C13	Monolithic, .1 µF, 50V	230-37
C14	Mica, 20 pF	220-20
C15	Mica, 20 pF	220-20
C16	Mica, 20 pF	220-20
C17	Monolithic, .1 µF, 50V	230-37
C18	Monolithic, .1 µF, 50V	230-37
C19	Monolithic, .1 µF, 50V	230-37
C20	Monolithic, .1 µF, 50V	230-37
C21	Mica, 3 pF	223-3
C22	Mica, 3 pF	223-3
C23	Monolithic, .1 µF, 50V	230-37
C24	Monolithic, .1 µF, 50V	230-37
C25	Monolithic, .1 µF, 50V	230-37
C26	Monolithic, .1 µF, 50V	230-37
C27	Monolithic, .01 µF, 100V	250-77
C28	Monolithic, .01 µF, 100V	250-77
C29	Mica, 150 pF	220-150
C30	Tantalum, 10 µF, 25V	250-42
C31	Monolithic, .1 µF, 50V	230-37
C32	Tantalum, 10 µF, 25V	250-42
C33	Monolithic, .01 µF, 100V	250-77
C34	Monolithic, .1 µF, 50V	230-37
C35	Monolithic, .1 µF, 50V	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Reference, 1N823, 6V, 0.4W	10-1N823
CR2	Shottky, MBD-501	10-4
CR3	Not Used	
CR4	Shottky, MBD-501	10-4
CR5	Not Used	
CR6	Shottky, MBD-501	10-4
CR7	Not Used	
CR8	Zener, 30V, 5%, 1W	10-1N4751A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446
CR12	Silicon, 1N4446	10-1N4446
CR13	Silicon, 1N4446	10-1N4446
CR14	Silicon, 1N4446	10-1N4446
CR15	Silicon, 1N4446	10-1N4446
CR16	Silicon, 1N4446	10-1N4446
CR17	Zener, 30V, 5%, 1W	10-1N4751A
CR18	Silicon, 1N4446	10-1N4446
CR19	Silicon, 1N4446	10-1N4446
CR20	Silicon, 1N4446	10-1N4446
CR21	Silicon, 1N4446	10-1N4446
CR22	Silicon, 1N4446	10-1N4446
CR23	Zener, 3.3V, 5%, .4W	10-1N746A
CR24	Silicon, 1N4446	10-1N4446
CR25	Silicon, 1N4446	10-1N4446
CR26	Silicon, 1N4446	10-1N4446
CR27	Zener, 4.7V, 5%, .4W	10-11
CR28	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	FET, J112	20-17
Q2	FET, J112	20-17
Q3	FET, J112	20-17
Q4	NPN, 2N3694	20-2N3694
Q5	NPN, 2N3694	20-2N3694
Q6	NPN, 2N3694	20-2N3694

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R2	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R3	MF, 1/4W, 1%, 10 kΩ	110-10k-1

R4	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R5	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R6	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R7	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R8	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R9	MF, 1/4W, 1%, 16.2 kΩ	110-16.2k-1
R10	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R11	MF, 1/4W, 1%, 16.2 kΩ	110-16.2k-1
R12	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R13	Variable, 1/2W, 10%, 2 kΩ	156-2k
R14	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R15	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R16	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R17	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R18	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	Variable, 1/2W, 10%, 2 kΩ	156-2k
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R24	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R25	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	Variable, 1/2W, 10%, 2 kΩ	156-2k
R28	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R29	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R30	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R31	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R32	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R35	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R36	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R37	MF, 1/4W, 1%, 24.9 kΩ	110-24.9k-1
R38	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R39	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R40	MF, 1/4W, 1%, 133 kΩ	110-133k-1
R41	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R42	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R43	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R44	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 24.9 kΩ	110-24.9k-1
R47	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R48	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R49	MF, 1/4W, 1%, 133 kΩ	110-133k-1
R50	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R51	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R52	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R53	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R56	MF, 1/4W, 1%, 24.9 kΩ	110-24.9k-1
R57	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R58	MF, 1/4W, 1%, 200 kΩ	110-200k-1
R59	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R60	MF, 1/4W, 1%, 887Ω	110-887-1
R61	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R62	Variable, 1/2W, 10%, 200 kΩ	156-200k
R63	MF, 1/4W, 1%, 19.6 kΩ	110-19.6k-1
R64	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R65	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R66	MF, 1/4W, 1%, 1.47 kΩ	110-1.47k-1
R67	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R68	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R69	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R70	MF, 1/4W, 1%, 301 kΩ	110-301k
R71	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R72	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R75	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R76	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R77	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R78	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R79	MF, 1/4W, 1%, 30.1 kΩ	110-30.1k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 178 kΩ	110-178k-1
R85	MF, 1/4W, 1%, 27.4 kΩ	110-27.4k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R87	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R88	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R89	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R90	Variable, 1/2W, 10%, 200 kΩ	156-200k
R91	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R92	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R93	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R94	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R95	MF, 1/4W, 1%, 1 kΩ	110-1k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Octal Latch, 74LS374	54-41
U2	Quad NAND Gate, 74LS01	54-74LS01
U3	Op Amp, TL072CP	54-53
U4	Not Used	
U5	8 Bit DAC, AD7524	54-129
U6	8 Bit DAC, AD7524	54-129
U7	8 Bit DAC, AD7524	54-129
U8	Quad Op Amp, RC4136	54-RC4136
U9	Quad Op Amp, RC4136	54-RC4136
U10	Quad Op Amp, RC4136	54-RC4136
U11	Quad AND Gate, 74LS09	54-96
U12	Voltage Comparator, LM311	54-30
U13	Op Amp, TL072CP	54-53
U14	Op Amp, LM339	54-45
U15	Dual Flip-Flop, 74LS74	54-44
U16	Dual One-Shot, 96L02	54-96L02
U17	2-input NAND, 74LS10	54-42
U18	8 Bit ADC, ADC0804LCN	54-161
U19	Octal Latch, 74LS374	54-41

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
TP1 thru TP19	Test Points	706-44
---	Ejector, PCB	553-96

Table 6-4. A4 ALC (660-D-8004)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Ceramic Disc, .1 µF	230-37
C2	Ceramic Disc, .1 µF	230-37
C3	Tantalum, 25V, 10 µF	250-42
C4	Tantalum, 25V, 10 µF	250-42
C5	Tantalum, 6V, 68 µF	250-58
C6	Ceramic Disc, .1 µF	230-37
C7	Ceramic Disc, .1 µF	230-37
C8	Ceramic Disc, .1 µF	230-37
C9	Ceramic Disc, .1 µF	230-37
C10	Mica, 27 pF	220-27
C11	Ceramic Disc, .1 µF	230-37
C12	Ceramic Disc, .1 µF	230-37
C13	Ceramic Disc, .1 µF	230-37
C14	Ceramic Disc, .1 µF	230-37
C15	Polycarbonate, .0047 µF	210-50
C16	Polycarbonate, .0047 µF	210-50
C17	Ceramic Disc, .1 µF	230-37
C18	Ceramic Disc, .01 µF	230-11
C19	Ceramic Disc, .0047 µF	230-36
C20	Ceramic Disc, .02 µF	230-27
C21	Ceramic Disc, .1 µF	230-37
C22	Ceramic Disc, .1 µF	230-37
C23	Aluminum, 63V, 47 µF	250-51
C24	Not Used	
C25	Ceramic Disc, .01 µF	230-11

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, 1N4446	10-1N4446
CR5	Silicon, 1N4446	10-1N4446
CR6	Silicon, 1N4446	10-1N4446
CR7	Reference, 6.2V, 1N823	10-1N823
CR8	Zener, 5.1V, 0.4W, 1N751A	10-1N751A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446
CR12	Silicon, 1N4446	10-1N4446
CR13	Silicon, 1N4446	10-1N4446
CR14	Silicon, 1N4446	10-1N4446
CR15	MBD-501	10-4
CR16	Silicon, 1N4446	10-1N4446
CR17	Silicon, 1N4446	10-1N4446
CR18	MBD-501	10-4
CR19	Silicon, 1N4446	10-1N4446
CR20	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	NPN, .5W, 2N2222A	20-2N2222A
Q2	PNP, .4W, 2N4249	20-2N4249
Q3	PNP, .4W, 2N4249	20-2N4249
Q4	NPN, .4W, 2N3694	20-2N3694
Q5	NPN, .4W, 2N3694	20-2N3694

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R2	MF, 1/4W, 1%, 8.25 kΩ	110-8.25k-1
R3	Variable, Single-Turn, 10 kΩ	156-10k
R4	MF, 1/4W, 1%, 3.01 kΩ	110-3.01k-1
R5	Variable, Multi-turn, 20 kΩ	157-20k
R6	MF, 1/4W, 1%, 3.01 kΩ	110-3.01k-1
R7	MF, 1/4W, 1%, 13.3 kΩ	110-13.3k-1
R8	MF, 1/4W, 1%, 54.9 kΩ	110-54.9k-1
R9	Variable, Single-Turn, 20 kΩ	156-20k
R10	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R11	Variable, Multi-turn, 20 kΩ	157-20k
R12	MF, 1/4W, 1%, 8.25 kΩ	110-8.25k-1
R13	MF, 1/4W, 1%, 64.9 kΩ	110-64.9k-1
R14	MF, 1/4W, 1%, 316 kΩ	110-316k-1
R15	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R16	MF, 1/4W, 1%, 64.9 kΩ	110-64.9k-1
R17	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R18	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R19	Variable, Multi-turn, 20 kΩ	157-20k
R20	MF, 1/4W, 1%, 64.9 kΩ	110-64.9k-1
R21	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R22	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R23	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R24	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R25	MF, 1/4W, 1%, 1.07 kΩ	110-1.07k-1
R26	MF, 1/4W, 1%, 19.6 kΩ	110-19.6k-1
R27	MF, 1/4W, 1%, 12.1 kΩ	110-12.1k-1
R28	MF, 1/4W, 1%, 10.2 kΩ	110-10.2k-1
R29	MF, 1/4W, 1%, 16.5 kΩ	110-16.5k-1
R31	MF, 1/4W, 1%, 51.1Ω	110-51.1-1
R32	MF, 1/4W, 1%, 51.1Ω	110-51.1-1
R34	MF, 1/4W, 1%, 511Ω	110-511-1
R35	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R36	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R37	MF, 1/4W, 1%, 511Ω	110-511-1
R38	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R39	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R40	MF, 1/4W, 0.1%, 900Ω	113-900-0.1
R41	MF, 1/4W, 0.1%, 900Ω	113-900-0.1
R42	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R43	MF, 1/4W, 1%, 261Ω	110-261-1
R44	MF, 1/4W, 1%, 261Ω	110-261-1
R45	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R46	MF, 1/4W, 1%, 604Ω	110-604-1
R47	MF, 1/4W, 1%, 576Ω	110-576-1
R48	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R49	MF, 1/4W, 1%, 1.82 kΩ	110-1.82k-1
R50	MF, 1/4W, 1%, 953Ω	110-953-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 54.9 kΩ	110-54.9k-1
R53	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R54	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R55	MF, 1/4W, 1%, 487Ω	110-487-1
R56	MF, 1/4W, 1%, 464Ω	110-464-1
R57	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R58	MF, 1/4W, 1%, 2.43 kΩ	110-2.43k-1
R59	MF, 1/4W, 1%, 2.05 kΩ	110-2.05k-1
R60	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R61	MF, 1/4W, 1%, 12.4 kΩ	110-12.4k-1
R62	MF, 1/4W, 0.1%, 20 kΩ	113-20k-0.1
R63	MF, 1/4W, 0.1%, 20 kΩ	113-20k-0.1
R64	MF, 1/4W, 0.1%, 20 kΩ	113-20k-0.1
R65	MF, 1/4W, 0.1%, 20 kΩ	113-20k-0.1

R66	Variable, Multi-turn, 2 kΩ	157-2k
R67	MF, 1/4W, 1%, 2.37 kΩ	110-2.37k-1
R68	Variable, Multi-turn, 2 kΩ	157-2k
R69	MF, 1/4W, 1%, 1.47 kΩ	110-1.47k-1
R70	Variable, Multi-turn, 2 kΩ	157-2k
R71	MF, 1/4W, 1%, 6.19 kΩ	110-6.19k-1
R72	Variable, Multi-turn, 2 kΩ	157-2k
R73	MF, 1/4W, 1%, 7.87 kΩ	110-7.87k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R76	CC, 1/4W, 5%, 10 MΩ	101-10M-5
R77	MF, 1/4W, 1%, 133 kΩ	110-133k-1
R78	MF, 1/4W, 1%, 2.49 kΩ	110-2.49k-1
R79	MF, 1/4W, 1%, 8.66 kΩ	110-8.66k-1
R80	Variable, Single-Turn, 2 kΩ	156-2k
R81	MF, 1/4W, 1%, 6.49 kΩ	110-6.49k-1
R82	Variable, Single-Turn, 2 kΩ	156-2k
R83	MF, 1/4W, 1%, 11.3 kΩ	110-11.3k-1
R84	Variable, Single-Turn, 2 kΩ	156-2k
R85	MF, 1/4W, 1%, 8.25 kΩ	110-8.25k-1
R86	Variable, Single-Turn, 2 kΩ	156-2k
R87	MF, 1/4W, 1%, 8.66 kΩ	110-8.66k-1
R88	Variable, Single-Turn, 2 kΩ	156-2k
R89	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R90	Variable, Single-Turn, 5 kΩ	156-5k
R91	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R92	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R93	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R94	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R95	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R96	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R97	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R98	MF, 1/4W, 1%, 1 MΩ	110-1M-1A
R99	MF, 1/4W, 1%, 26.7 kΩ	110-26.7k-1
R100	MF, 1/4W, 1%, 42.2 kΩ	110-42.2k-1
R101	MF, 1/4W, 1%, 30.1 kΩ	110-30.1k-1
R102	MF, 1/4W, 1%, 30.1 kΩ	110-30.1k-1
R103	Variable, Multi-turn, 5 kΩ	157-5k
R104	MF, 1/4W, 1%, 301 kΩ	110-301k-1
R105	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R106	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R107	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R108	MF, 1/4W, 1%, 511 kΩ	110-511k-1
R109	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R110	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R111	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R112	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R113	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R114	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R115	Variable, Single-Turn, 20 kΩ	156-20k
R116	MF, 1/4W, 1%, 16.5 kΩ	110-16.5k-1
R117	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R118	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R119	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R120	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R121	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R122	MF, 1/4W, 1%, 511Ω	110-511-1
R123	Variable, Single-Turn, 2 kΩ	156-2k
R124	Variable, Single-Turn, 2 kΩ	156-2k
R125	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R126	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R127	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R128	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R129	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R130	MF, 1/4W, 1%, 4.02 kΩ	110-4.02k-1
R131	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R132	MF, 1/4W, 1%, 4.02 kΩ	110-4.02k-1
R133	MF, 1/4W, 1%, 4.02 kΩ	110-4.02k-1
R134	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R135	MF, 1/4W, 1%, 4.02 kΩ	110-4.02k-1
R136	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R137	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R138	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R139	MF, 1/4W, 1%, 649Ω	110-649-1
R140	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R141	MF, 1/4W, 1%, 887Ω	110-887-1
R142	Variable, Single-Turn, 20 kΩ	156-20k
R143	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R144	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R145	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R146	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R147	MF, 1/4W, 1%, 3.01 kΩ	110-3.01k-1
R148	MF, 1/4W, 1%, 10 kΩ	110-10k-1
RP1	Package, 1 kΩ	123-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad NAND, 74LS00	54-74LS00
U2	Hex Inverter, 74LS04	54-74LS04
U3	Triple NAND, 74LS10	54-42
U4	Op Amp, LF356N	50-9
U5	Switch, DG201	54-24
U6	Op Amp, LF356N	50-9
U7	Op Amp, LF356N	50-9
U8	Op Amp, TL072	54-53
U9	Op Amp, TL072	54-53
U10	Op Amp, TL072	54-53
U11	Quad Comparator, MC3302P	54-MC3302P
U12	Transistor Array, CA3054	54-6
U13	Transistor Array, CA3054	54-6
U14	Op Amp, LF356N	50-9
U15	Transistor Array, CA3054	54-6
U16	Op Amp, TL072	54-53
U17	Switch, DG201	54-24
U18	Op Amp, TL074	54-132
U19	Op Amp, TL074	54-132
U20	Switch, DG201	54-24
U21	Op Amp, LF356N	50-9
U22	8 Bit DAC, AD 7524	54-129
U23	Quad Schmitt NAND, 74LS132	54-74LS132
U24	Octal Latch, 74LS374	54-41
U25	Quad Transparent Latch, 74LS75	54-74LS75

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
TP1 thru TP7	Pin, Test Point	706-44
----	Ejector, PC Board	553-96

Table 6-5. A5 Frequency Instruction (660-D-8005)

CAPACITORS

REF DES.	DESCRIPTION	WILTRON PART NO.
C1	Mica, 100 pF	220-100
C2	Mica, 100 pF	220-100
C3	Disc Ceramic, 0.001 µF	230-30
C4	Monolithic, 0.1 µF	230-37
C5	Tantalum, 4.7 µF, 35V	250-39
C6	Monolithic, 0.1 µF	230-37
C7	Tantalum, 4.7 µF, 35V	250-39
C8	Monolithic, 0.1 µF	230-37
C9	Monolithic, 0.1 µF	230-37
C10	Monolithic, 0.1 µF	230-37
C11	Monolithic, 0.1 µF	230-37
C12	Tantalum, 4.7 µF, 35V	250-39
C13	Tantalum, 4.7 µF, 35V	250-39
C14	Monolithic, 0.1 µF	230-37
C15	Monolithic, 0.1 µF	230-37
C16	Tantalum, 4.7 µF, 35V	250-39
C17	Tantalum, 4.7 µF, 35V	250-39
C18	Monolithic, 0.1 µF	230-37
C19	Monolithic, 0.1 µF	230-37
C20	Tantalum, 4.7 µF, 35V	250-39
C21	Tantalum, 4.7 µF, 35V	250-39
C22	Monolithic, 0.1 µF	230-37
C23	Monolithic, 0.1 µF	230-37
C24	Monolithic, 0.1 µF	230-37
C25	Disc Ceramic, 0.001 µF	230-30
C26	Mica, 100 pF	220-100
C27	Disc Ceramic, 0.001 µF	230-30

DIODES

REF DES.	DESCRIPTION	WILTRON PART NO.
CR1	Schottky, MBD-501	10-4
CR2	Schottky, MBD-501	10-4
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, 1N4446	10-1N4446
CR5	Zener, 12V, 0.4W, 1N759A	10-1N759A
CR6	Reference, 6.2V, 1N823	10-1N823
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 11V, 1N962B	10-1N962B
CR10	Zener, 11V, 1N962B	10-1N962B

TRANSISTORS

REF DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, 2N6041	20-2N6041
Q2	PNP, 2N2907A	20-2N2907A
Q3	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
A1	Resistor Pack	
	a. 6609A	660-A-8145-1
	b. 6617A	660-A-8145-2
	c. 6621A	SPCL-A-11552
	d. 6621A-40	SPCL-A-13074
	e. 6629A	SPCL-A-11587
	f. 6629A-40	SPCL-A-13081
	g. 6637A	660-A-8145-3
	h. 6637A-40	660-A-8145-3
	i. 6638A	660-A-8145-4
	j. 6642A	SPCL-A-11623
	k. 6647A	660-A-8145-3
	l. 6648A	660-A-8145-4
	m. 6653A	660-A-8145-5
	n. 6659A	660-A-8145-5
A2	Resistor Pack	
	a. 6609A	660-A-12632-1
	b. 6617A	660-A-12732-2
	c. 6621A	SPCL-B-13091-5
	d. 6621A-40	SPCL-B-13091-5
	e. 6629A	SPCL-B-13091-9
	f. 6629A-40	SPCL-B-13091-9
	g. 6637A	660-A-12632-3
	h. 6637A-40	660-A-12632-3
	i. 6638A	660-A-12632-5
	j. 6642A	SPCL-B-13091-13
	k. 6647A	660-A-12632-4
	l. 6648A	660-A-12632-6
	m. 6653A	660-A-12632-9
	n. 6659A	660-A-12632-10
RP1	Resistor Pack, 10 kΩ	123-6
R1	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R2	MF, 1/4W, 1%, 2.37 kΩ	110-2.37k-1
R3	MF, 1/4W, 1%, 2.37 kΩ	110-2.37k-1
R4	MF, 1/4W, 1%, 3.92 kΩ	110-3.92k-1
R5	MF, 1/4W, 1%, 392Ω	110-392-1
R6	Part of A2	
R7	Part of A2	
R8	Variable, Multi-turn, 50 kΩ	157-50k
R9	MF, 1/4W, 1%, 348 kΩ	110-348k-1
R10	Variable, Multi-turn, 20 kΩ	157-20k
R11	MF, 1/4W, 0.1%, 30 kΩ	113-30k-0.1
R12	MF, 1/4W, 1%, 511Ω	110-511-1
R13	Variable, Single-Turn, 500Ω	156-500
R14	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R15	MF, 1/4W, 0.1%, 30 kΩ	113-30k-0.1
R16	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	Part of A2	
R19	Part of A2	
R20	Part of A2	
R21	Part of A2	
R22	Part of A2	
R23	MF, 1/4W, 0.1%, 30 kΩ	113-30k-0.1
R24	MF, 1/4W, 1%, 511Ω	110-511-1
R25	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R26	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R27	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R28	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R29	Variable, Multi-turn, 500Ω	157-500
R30	MF, 1/4W, 0.1%, 30 kΩ	113-30k-0.1
R31	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R32	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R33	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R34	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R35	MF, 1/4W, 1%, 27.4 kΩ	110-27.4k-1
R36	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R37	Part of A2	
R38	Part of A2	
R39	MF, 1/4W, 1%, 511Ω	110-511-1
R40	Variable, Multi-turn, 20k	157-20k
R41	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1

R42	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R43	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R44	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R45	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R46	Variable, Multi-turn, 20k	157-20k
R47	MF, 1/4W, 1%, 10Ω	110-10-1
R48	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R49	Variable, Single-Turn, 1 kΩ	157-1k
R50	MF, 1/4W, 1%, 6.49 kΩ	110-6.49k-1
R51	MF, 1/4W, 1%, 4.32 kΩ	110-4.32k-1
R52	MF, 1/4W, 1%, 422Ω	110-422-1
R53	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R54	MF; 1/4W, 1%, 1 kΩ	110-1k-1
R55	Variable, Single-Turn, 1 kΩ	157-1k
R56	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R57	MF, 1/4W, 1%, 1.87 kΩ	110-1.87k-1
R58	MF, 1/4W, 1%, 10Ω	110-10-1
R59	MF, 1/4W, 0.1%, 10 kΩ	113-10k-0.1
R60	MF, 1/4W, 1%, 3.92 kΩ	110-3.92k-1
R61	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R62	Variable, Single-Turn, 5k	156-5k
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1% 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R66	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R67	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R68	Variable, Multi-turn, 2 kΩ	157-2k
R69	Variable, Multi-turn, 2 kΩ	157-2k
R70	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R71	Part of A2	
R72	Part of A2	
R73	Part of A2	
R74	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R75	Variable, Single-Turn, 5 kΩ	156-5k
R76	MF, 1/4W, 1%, 3.16 kΩ	110-3.16k-1
R77	Variable, Single-Turn, 5 kΩ	156-5k
R78	MF, 1/4W, 1%, 2.49 kΩ	110-2.49k-1
R79	Variable, Single-Turn, 5 kΩ	156-5k
R80	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R81	Variable, Single-Turn, 5 kΩ	156-5k
R82	MF, 1/4W, 1%, 3.01 kΩ	110-3.01k-1
R83	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R84	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R85	Part of A2	
R86	Part of A2	
R87	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R88	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R89	MF, 1/4W, 1%, 10 kΩ	110-10k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Hex Inverter, 74LS00	54-74LS00
U2	8 Bit Multiplying DAC, MC1408L8	54-148
U3	Op Amp, 356	50-9
U4	8 Bit Multiplying DAC, MC1408L8	54-148
U5	Octal Latch, 74LS374	54-41
U6	Op Amp, OP05	50-87
U7	16 Bit DAC	54-150
U8	Octal Latch, 74LS374	54-41
U9	Octal Latch, 74LS374	54-41
U10	Dual FET-Input Op Amp, TL072	54-53
U11	Dual Analog Switch, DG200BA	50-DG200BA
U12	Op Amp, 301A	50-8
U13	Op Amp, 356	50-9
U14	Op Amp, 356	50-9
U15	Octal Latch, 74LS374	54-41
U16	Octal Latch, 74LS374	54-41
U17	Octal Latch, 74LS374	54-41
U18	Octal Latch, 74LS374	54-41
U19	12 Bit Multiplying DAC	54-149
U20	Op Amp, 356	50-9
U21	Dual FET-Input Op Amp, TL072	54-53
U22	Quad Analog Switch, LF13201N	54-20
U23	Op Amp, 356	50-9
U24	12 Bit Multiplying DAC	54-149
U25	Op Amp, 356	50-9
U26	Op Amp, OP05	50-87
U27	Dual FET-Input Op Amp, TL072	54-53
U28	Quad Analog Switch, LF13201N	54-20
U29	Triple NAND, 74LS10	54-42
U30	Op AMp, 356	50-9
U31	Quad D Flip-Flop, 74LS175	54-74LS175
U32	Octal Latch, 74LS374	54-41
U33	Quad Analog-Switch, LF13201N	54-20
U34	Quad Analog-Switch, LF13201N	54-20
U35	Dual FET-Input Op Amp, TL074	54-132

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
P2	Connector, 3-Pin	551-238
S1	Switch, DPDT	420-14
TP1 thru TP10	Pin, Test Point	706-44
----	Socket, I.C., 14-Pin	553-63
----	Socket, I.C. 24-Pin	553-67
----	Ejector, P.C. Board	553-96

Table 6-6. A6 HET/YIG Driver, .01 - 2 GHz, 6609A (660-D-8007-4)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 μF	230-37
C2	Monolithic, .1 μF	230-37
C3	Tantalum, 35V, 6.8 μF	250-41
C4	Monolithic, .1 μF	230-37
C5	Tantalum, 35V, 6.8 μF	250-41
C6	Monolithic, .1 μF	230-37
C7	Tantalum, 35V, 6.8 μF	250-41
C8	Monolithic, .1 μF	230-37
C9	Ceramic, .01 μF	230-11
C10	Ceramic, .001 μF	230-30
C11	Tantalum, 1 μF, 35V	250-19
C12	Tantalum, 1 μF, 35V	250-19
C13	Monolithic, 1 μF	230-41
C14	Monolithic, .1 μF	230-37
C15	Mica, 300 pF	220-300

C16	Tantalum, 35V, 6.8 µF	250-41
C18	Ceramic, .01 µF	230-11
C19	Tantalum, 35V, 6.8 µF	250-41
C21	Mica, 8.2 pF	221-8.2
C22	Mica, 820 pF	220-820
C23	Ceramic, .01 µF	230-11
C24	Ceramic, .01 µF	230-11
C25	Ceramic, .01 µF	230-11

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, SI2	10-SI2
CR5	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Zener, 6.8V, 1W, 1N4736A	10-1N4736A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N2222A	20-2N2222A
Q4	PNP, 2N2907A	20-2N2907A
Q5	NPN, 2N2222A	20-2N2222A
Q6	NPN, 2N3694	20-2N3694
Q7	NPN, MPSU04	20-MPSU04
Q8	PNP, 2N2907A	20-2N2907A
Q9	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	Variable, 1-Turn, 20 kΩ	156-20K
R2	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R3	Variable, 10-Turn 1 kΩ	157-1k
R4	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R5	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R6	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 10-Turn, 20 kΩ	157-20k
R10	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R11	MF, 1/4W, 1%, 511Ω	110-511-1
R12	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R13	MF, 1/4W, 1%, 9.09 kΩ	110-9.09k-1
R14	MF, 1/4W, 1%, 1.10 kΩ	110-1.10k-1
R15	WW, 5W, 5Ω	131-3
R16	MF, 1/4W, 1%, 511Ω	110-511-1
R17	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R18	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 121Ω	110-121-1
R24	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R25	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R26	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R27	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R43	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R44	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R45	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R46	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R47	MF, 1/4W, 1%, 511Ω	110-511-1
R48	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R49	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R50	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R51	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R66	Variable, 1-Turn, 500 kΩ	156-500k
R67	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R70	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R71	MF, 1/4W, 1%, 1.30 kΩ	110-1.30k-1
R72	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R73	MF, 1/4W, 1%, 3.40 kΩ	110-3.40k-1
R74	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R75	MF, 1/4W, 1%, 301Ω	110-301-1
R76	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R77	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R78	MF, 1/4W, 1%, 511Ω	110-511-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R82	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R88	Variable, 1-Turn, 20Ω	156-20
R89	MF, 1/4W, 1%, 15 kΩ	110-15k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U4	Op-Amp, OP05	54-87
U5	2k x 8 EPROM, 2716	Not Field-Replaceable
U8	Dual Op-Amp, TL072	54-53
U10	Input NAND Gate, 74LS10	54-42

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, P.C. Board	553-96
TP1 thru TP5	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-7. A6 HET/YIG Driver, 2-8 GHz, 6617A (660-D-8007-6)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 µF	230-37
C2	Monolithic, .1 µF	230-37
C3	Tantalum, 35V, 6.8 µF	250-41A
C4	Monolithic, .1 µF	230-37
C5	Tantalum, 35V, 6.8 µF	250-41A
C6	Monolithic, .1 µF	230-37
C7	Tantalum, 35V, 6.8 µF	250-41A
C8	Monolithic, .1 µF	230-37
C9	Ceramic, .01 µF	230-11
C10	Ceramic, .001 µF	230-30
C11	Tantalum, 1 µF, 35V	250-19
C12	Tantalum, 1 µF, 35V	250-19
C13	Monolithic, 1 µF	230-41
C14	Monolithic, .1 µF	230-37
C15	Mica, 300 pF	220-300
C16	Tantalum, 35V, 6.8 µF	250-41A
C17	Ceramic, .001 µF	230-30
C18	Ceramic, .01 µF	230-11
C19	Tantalum, 35V, 4.7 µF	250-39
C21	Mica, 8.2 pF	221-8.2
C22	Ceramic, .01 µF	230-11
C23	Ceramic, .01 µF	230-11
C24	Ceramic, .01 µF	230-11
C25	Ceramic, .01 µF	230-11
C26	Monolithic, .1 µF	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, SI2	10-SI2
CR5	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Zener, 6.8V, 1W, 1N4736A	10-1N4736A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N2907A	20-2N2907A
Q4	NPN, 2N2222A	20-2N2222A
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N3694	20-2N3694
Q7	NPN, MPSU04	20-MPSU04
Q8	PNP, 2N2907A	20-2N2907A
Q9	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	Variable, 1-Turn, 20 kΩ	156-20K
R2	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R3	Variable, 10-Turn 1 kΩ	157-1k
R4	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R5	Variable, 10-Turn, 50 kΩ	157-50k
R6	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 10-Turn, 20 kΩ	157-20k
R10	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R11	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R12	Variable, 10-Turn, 5 kΩ	157-5k
R13	MF, 1/4W, 1%, 56.3 kΩ	110-56.3k-1
R14	MF, 1/4W, 1%, 4.22 kΩ	110-4.22k-1
R15	WW, 5W, 5Ω	131-3
R16	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R17	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R18	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 121Ω	110-121-1
R24	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R25	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R26	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R27	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R28	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R29	MF, 1/4W, 1%, 562 kΩ	110-562k-1
R30	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R31	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R32	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R33	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R34	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R35	MF, 1/4W, 1%, 562 kΩ	110-562k-1
R36	Variable, 10-Turn, 2 kΩ	157-2k
R37	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R38	Variable, 10-Turn, 50 kΩ	157-50k
R39	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R40	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R43	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R44	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R45	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R46	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R47	MF, 1/4W, 1%, 511Ω	110-511-1
R48	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R49	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R50	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R51	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R52	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R53	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R56	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R57	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R58	Variable, 10-Turn, 500Ω	157-500
R59	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R62	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

R63	MF, 1/4W, 1%, 6.49 kΩ	110-6.49k-1
R64	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R65	Variable, 10-Turn, 500Ω	157-500
R66	Variable, 1-Turn, 500 kΩ	156-500k
R67	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R68	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R69	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R70	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R71	MF, 1/4W, 1%, 1.30 kΩ	110-1.30k-1
R72	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R73	MF, 1/4W, 1%, 3.40 kΩ	110-3.40k-1
R74	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R75	MF, 1/4W, 1%, 301Ω	110-301-1
R76	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R77	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R78	MF, 1/4W, 1%, 511Ω	110-511-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 110 kΩ	110-110k-1
R82	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R83	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R84	MF, 1/4W, 1%, 1 MΩ	110-1M-1
R85	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R87	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R88	Variable, 1-Turn, 20Ω	156-20
R89	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R91	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R92	MF, 1/4W, 1%, 511Ω	110-511-1
R93	MF, 1/4W, 1%, 511Ω	110-511-1
R94	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R95	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R96	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R97	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R98	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R99	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R100	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad EX-OR Gate, 74LS86	54-125
U2	Quad Op Amp, TL074	54-132
U3	Quad Analog Switch, LF13201	54-20
U4	Op-Amp, OP05	54-87
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Dual Analog Switch, DG200	50-DG200BA
U8	Dual Op-Amp, TL072	54-53
U9	Quad Volt Comparator, MC3302P	54-MC3302P
U10	Input NAND Gate, 74LS10	54-42

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, P.C. Board	553-96
TP1 thru TP5	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-8. A6 HET/YIG Driver, 2-8 GHz, 6621A/6637A/6638A/6647A/6648A (660-D-8007-3, -5, -99-91)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 µF	230-37
C2	Monolithic, .1 µF	230-37
C3	Tantalum, 35V, 6.8 µF	250-41
C4	Monolithic, .1 µF	230-37
C5	Tantalum, 35V, 6.8 µF	250-41
C6	Monolithic, .1 µF	230-37
C7	Tantalum, 35V, 6.8 µF	250-41
C8	Monolithic, .1 µF	230-37
C9	Ceramic, .01 µF	230-11
C10	Ceramic, .001 µF	230-30
C11	Tantalum, 1 µF, 35V	250-19
C12	Tantalum, 1 µF, 35V	250-19
C13	Monolithic, 1 µF	230-41
C14	Monolithic, .1 µF	230-37
C15	Mica, 300 pF	220-300
C16	Tantalum, 35V, 6.8 µF	250-41
C18	Ceramic, .01 µF	230-11
C19	Tantalum, 35V, 6.8 µF	250-41
C21	Mica, 8.2 pF	221-8.2
C22	Mica, 820 pF	220-820
C23	Ceramic, .01 µF	230-11
C24	Ceramic, .01 µF	230-11
C25	Ceramic, .01 µF	230-11

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, SI2	10-SI2
CR5	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Zener, 6.8V, 1W, 1N4736A	10-1N4736A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N2907A	20-2N2907A
Q4	NPN, 2N2222A	20-2N2222A
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N3694	20-2N3694

Q7	NPN, MPSU04	20-MPSU04
Q8	PNP, 2N2907A	20-2N2907A
Q9	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	Variable, 1-Turn, 20 kΩ	156-20k
R2	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R3	Variable, 10-Turn 1 kΩ	157-1k
R4	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R5	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R6	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 10-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R12	Variable, 10-Turn, 20 kΩ	157-20k
R13	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R14[1]	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R14[2]	MF, 1/4W, 1%, 10.2k	110-10.2k-1
R14[3]	MF, 1/4W, 1%, 6.65k	110-6.65k-1
R15	WW, 5W, 5Ω	131-3
R16	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R17[1]	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R17[2]	MF, 1/4W, 1%, 3.16k	110-3.16k-1
R17[3]	MF, 1/4W, 1%, 3.24k	110-3.24k-1
R18	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 121Ω	110-121-1
R24	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R25	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R26	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R27	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R28	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R29[1]	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R29[2]	MF, 1/4W, 1%, 526Ω	110-526-1
R30	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R31	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R32	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R33	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R34	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R35[1]	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R35[2]	MF, 1/4W, 1%, 526Ω	110-526-1
R36	Variable, 10-Turn, 2 kΩ	157-2k
R37	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R38	Variable, 10-Turn, 50 kΩ	157-50k
R39	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R40	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R43	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R44	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R45	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R46	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R47	MF, 1/4W, 1%, 511Ω	110-511-1
R48	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R49	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R50	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R51	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R52	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R53	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R56	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R57[1]	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R57[2]	MF, 1/4W, 1%, 3.16k	110-3.16k-1
R57[3]	MF, 1/4W, 1%, 2.74k	110-2.74k-1
R58	Variable, 10-Turn, 500Ω	157-500
R59	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R62	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R63[1]	MF, 1/4W, 1%, 18.2 kΩ	110-18.2k-1
R63[2]	MF, 1/4W, 1%, 20k	110-20k-1
R64	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R65	Variable, 10-Turn, 500Ω	157-500
R66	Variable, 1-Turn, 500 kΩ	156-500k
R67	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R68	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R69	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R70	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R71	MF, 1/4W, 1%, 1.30 kΩ	110-1.30k-1
R72	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R73	MF, 1/4W, 1%, 3.40 kΩ	110-3.40k-1
R74	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R75	MF, 1/4W, 1%, 301Ω	110-301-1
R76	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R77	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R78	MF, 1/4W, 1%, 511Ω	110-511-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R82	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R83	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R84	MF, 1/4W, 1%, 1 MΩ	110-1M-1
R85	Variable, 1-Turn, 100k	156-100k
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R87	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R88	Variable, 1-Turn, 20Ω	156-20
R89	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R90	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R90[3]	MF, 1/4W, 1%, 31.6k	110-31.6k-1
R91	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R91[3]	MF, 1/4W, 1%, 20k	110-20k-1
R92	MF, 1/4W, 1%, 511Ω	110-511-1
R93	MF, 1/4W, 1%, 511Ω	110-511-1
R94	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R95	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R96	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R97	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R98	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R99	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R100	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad EX-OR Gate, 74LS86	54-125
U2	Quad Op Amp, TL074	54-132
U3	Quad Analog Switch, LF13201	54-20
U4	Op-Amp, OP05	54-87
U5	2k x 8 EPROM, 2716	Not Field-Replaceable
U7	Dual Analog Switch, DG200	50-DG200BA
U8	Dual Op-Amp, TL072	54-53
U9	Quad Volt Comparator, MC3302P	54-MC3302P
U10	Input NAND Gate, 74LS10	54-42

---

[1] Used on 660-D-8007-3 assembly.

[2] Used on 660-D-8007-5 assembly.

[3] Used on 660-D-8007-99-91 assembly.

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, P.C. Board	553-96
TP1 thru TP5	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-9. A6 YIG Driver, 2-8 GHz, 6621A-40/6637A-40 (660-D-12868-3, -99-91)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 µF	230-37
C2	Monolithic, .1 µF	230-37
C3	Tantalum, 35V, 6.8 µF	250-41
C4	Monolithic, .1 µF	230-37
C5	Tantalum, 35V, 6.8 µF	250-41
C6	Monolithic, .1 µF	230-37
C7	Tantalum, 35V, 6.8 µF	250-41
C8	Monolithic, .1 µF	230-37
C9	Ceramic, .01 µF	230-11
C10	Ceramic, .001 µF	230-30
C11	Tantalum, 1 µF, 35V	250-19
C12	Tantalum, 1 µF, 35V	250-19
C13	Monolithic, 1 µF	230-41
C14	Monolithic, .1 µF	230-37
C15	Mica, 300 pF	220-300
C16	Tantalum, 35V, 6.8 µF	250-41
C17	Ceramic, .001 µF	230-30
C18	Ceramic, .01 µF	230-11
C19	Tantalum, 35V, 6.8 µF	250-41
C21	Mica, 8.2 pF	221-8.2
C22	Mica, 820 pF	220-820
C23	Ceramic, .01 µF	230-11
C24	Ceramic, .01 µF	230-11
C25	Ceramic, .01 µF	230-11
C26	Monolithic, .1 µF	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, SI2	10-SI2
CR5	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Zener, 6.8V, 1W, 1N4736A	10-1N4736A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N2907A	20-2N2907A
Q4	NPN, 2N2222A	20-2N2222A
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N3694	20-2N3694
Q7	NPN, MPSU04	20-MPSU04
Q8	PNP, 2N2907A	20-2N2907A
Q9	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	Variable, 1-Turn, 20 kΩ	156-20k
R2	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R3	Variable, 10-Turn, 1 kΩ	157-1k
R4	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R5	MF, 1/4W, 1%, 50 kΩ	110-50k-1
R6	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 10-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R12	Variable, 10-Turn, 20 kΩ	157-20k
R13	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R14	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R14[1]	MF, 1/4W, 1%, 6.65k	110-6.65k-1
R15	WW, 5W, 5Ω	131-3
R16	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R17	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R18	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 121Ω	110-121-1
R24	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R25	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R26	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R27	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R28	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R29	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R30	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R31	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R32	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R33	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R34	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R35	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R36	Variable, 10-Turn, 2 kΩ	110-2k-1
R37	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R38	Variable, 10-Turn, 50 kΩ	110-50k-1
R39	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R40	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R43	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R44	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R45	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R46	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R47	MF, 1/4W, 1%, 511Ω	110-511-1
R48	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R49	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R50	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R51	MF, 1/4W, 1%, 10 kΩ	110-10k-1

---

[1] Used on 660-D-12868-99-91

R52	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R53	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R56	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R57	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R58	Variable, 10-Turn, 500Ω	157-500
R59	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R62	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R63	MF, 1/4W, 1%, 18.2 kΩ	110-18.2k-1
R64	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R65	Variable, 10-Turn, 500Ω	157-500
R66	Variable, 1-Turn, 500 kΩ	156-500k
R67	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R68	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R69	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R70	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R71	MF, 1/4W, 1%, 1.30 kΩ	110-1.30k-1
R72	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R73	MF, 1/4W, 1%, 3.40 kΩ	110-3.40k-1
R74	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R75	MF, 1/4W, 1%, 301Ω	110-301-1
R76	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R77	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R78	MF, 1/4W, 1%, 511Ω	110-511-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R82	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R83	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R84	MF, 1/4W, 1%, 1 MΩ	110-1M-1
R85	Variable, 1-Turn, 100 kΩ	156-100k
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R87	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R88	Variable, 1-Turn 20Ω	156-20
R89	MF, 1/4W, 1%, 15k	110-15k-1
R90	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R90[1]	MF, 1/4W, 1%, 31.6 kΩ	110-31.6k-1
R91	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R91[1]	MF, 1/4W, 1%, 31.6 kΩ	110-31.6k-1
R92	MF, 1/4W, 1%, 511Ω	110-511-1
R93	MF, 1/4W, 1%, 511Ω	110-511-1
R94	Variable, 10-Turn, 20 kΩ	157-20k
R95	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R96	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R97	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R98	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U4	Op-Amp, OP05	54-87
U5	2k x 8 EPROM	Not Field-Replaceable
U8	Dual Op-Amp, TL072	54-53
U10	Input NAND Gate, 74LS10	54-42

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
—	Ejector, P.C. Board	553-96
TP1 thru TP5	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
—	Socket, I.C., 24-Pin	553-67

Table 6-10. A6 YIG Driver, 18-26.5 GHz, 6642A (660-D-8190-99-98)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF	250-19
C7	Tantalum, 1 µF	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 820 pF	220-820
C21	Mica, 39 pF	220-39

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N4249	20-2N4249
Q4	NPN, MPSU55	20-30

---

[1] Used on 660-D-12868-99-91

Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A
Q8	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 10-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/8W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 10-Turn, 1 kΩ	157-1k
R6	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R9	Variable, 10-Turn, 200 kΩ	157-200k
R10	MF, 1/8W, 1%, 301 kΩ	110-301k-1
R11	MF, 1/8W, 1%, 6.19 kΩ	110-6.19k-1
R12	MF, 1/8W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/8W, 1%, 2.61 kΩ	110-2.61k-1
R15	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R17	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/8W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/8W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/8W, 1%, 121Ω	110-121-1
R21	MF, 1/8W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/8W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/8W, 1%, 511Ω	110-511-1
R24	MF, 1/8W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 5Ω	131-3
R26	MF, 1/8W, 1%, 15.4 kΩ	110-15.4k-1
R27	MF, 1/8W, 1%, 649Ω	110-649-1
R28	MF, 1/8W, 1%, 6.19 kΩ	110-6.19k-1
R29	MF, 1/8W, 1%, 1.37 kΩ	110-1.37k-1
R30	MF, 1/8W, 1%, 3.83 kΩ	110-3.83k-1
R31	MF, 1/8W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/8W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/8W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 500 kΩ	156-500k
R35	MF, 1/8W, 1%, 49.9 kΩ	110-49.9k-1
R36	MF, 1/8W, 1%, 5.11 kΩ	110-5.11k-1
R37	MF, 1/8W, 1%, 5.11 kΩ	110-5.11k-1
R38	MF, 1/8W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/8W, 1%, 18.7 kΩ	110-18.7k-1
R40	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R41	MF, 1/8W, 1%, 133 kΩ	110-133k-1
R42	Variable, 10-Turn, 50 kΩ	157-50k
R43	MF, 1/8W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/8W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/8W, 1%, 14.7 kΩ	110-14.7k-1
R47	Variable, 10-Turn, 1 kΩ	157-1k
R48	MF, 1/8W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/8W, 1%, 511Ω	110-511-1
R51	MF, 1/8W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/8W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/8W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/8W, 1%, 511Ω	110-511-1
R55	CC, 1/2W, 5%, .5Ω	102-.5-5
R56	CC, 1/2W, 5%, .5Ω	102-.5-5
R57	MF, 1/8W, 1%, 5.11Ω	110-5.11-1
R58	MF, 1/8W, 1%, 5.11Ω	110-5.11-1
R60	MF, 1/8W, 1%, 2.15 kΩ	110-2.15k-1
R61	MF, 1/8W, 1%, 511Ω	110-511-1
R62	MF, 1/8W, 1%, 511Ω	110-511-1
R63	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/8W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/8W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/8W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 10-Turn, 500Ω	157-500
R69	MF, 1/8W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/8W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/8W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/8W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/8W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/8W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/8W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/8W, 1%, 14.7 kΩ	110-14.7k-1
R80	MF, 1/8W, 1%, 23.7 kΩ	110-23.7k-1
R81	MF, 1/8W, 1%, 23.7 kΩ	110-23.7k-1
R82	MF, 1/8W, 1%, 20 kΩ	110-20k-1
R83	MF, 1/8W, 1%, 20 kΩ	110-20k-1
R84	MF, 1/8W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/8W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/8W, 1%, 511Ω	110-511-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Dual Op Amp, TL072	54-53
U5	256 x 4 PROM,	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, P.C. Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-11. A6 HET/YIG Driver, 2-8 GHz, 6653A/6659A (660-D-8007-7)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 µF	230-37
C2	Monolithic, .1 µF	230-37
C3	Tantalum, 35V, 6.8 µF	250-41
C4	Monolithic, .1 µF	230-37
C5	Tantalum, 35V, 6.8 µF	250-41
C6	Monolithic, .1 µF	230-37
C7	Tantalum, 35V, 6.8 µF	250-41
C8	Monolithic, .1 µF	230-37
C9	Ceramic, .01 µF	230-11
C10	Ceramic, .001 µF	230-30
C11	Tantalum, 1 µF, 35V	250-19
C12	Tantalum, 1 µF, 35V	250-19
C13	Monolithic, 1 µF	230-41
C14	Monolithic, .1 µF	230-37
C15	Mica, 300 pF	220-300
C16	Tantalum, 35V, 6.8 µF	250-41
C17	Ceramic, .001 µF	230-30
C18	Ceramic, .01 µF	230-11
C19	Tantalum, 35V, 6.8 µF	250-41
C21	Mica, 8.2 pF	221-8.2
C22	Mica, 820 pF	220-820
C23	Ceramic, .01 µF	230-11
C24	Ceramic, .01 µF	230-11
C25	Ceramic, .01 µF	230-11
C26	Monolithic, .1µF	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, SI2	10-SI2
CR5	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Zener, 6.8V, 1W, 1N4736A	10-1N4736A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N2907A	20-2N2907A
Q4	NPN, 2N2222A	20-2N2222A
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N3694	20-2N3694
Q7	NPN, MPSU04	20-MPSU04
Q8	PNP, 2N2907A	20-2N2907A
Q9	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	Variable, 1-Turn, 20 kΩ	156-20K
R2	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R3	Variable, 10-Turn, 1 kΩ	157-1k
R4	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R5	Variable, 10-Turn, 50 kΩ	157-50k
R6	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R7	Variable, 10-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 10-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R12	Variable, 10-Turn, 20 kΩ	157-20k
R13	MF, 1/4W, 1%, 110 kΩ	110-110k-1
R14	MF, 1/4W, 1%, 14.0 kΩ	110-14.0k-1
R15	WW, 5W, 5Ω	131-3
R16	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R17	MF, 1/4W, 1%, 3.16 kΩ	110-3.16k-1
R18	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R22	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R23	MF, 1/4W, 1%, 121Ω	110-121-1
R24	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R25	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R26	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R27	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R28	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R29	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R30	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R31	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R32	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R33	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R34	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R35	MF, 1/4W, 1%, 536 kΩ	110-536k-1
R36	Variable, 10-Turn, 2 kΩ	157-2k
R37	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R38	Variable, 10-Turn, 50 kΩ	157-50k
R39	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R40	MF, 1/4W, 1%, 75 kΩ	110-75k-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R43	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R44	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R45	MF, 1/4W, 1%, 3.24 kΩ	110-3.24k-1
R46	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R47	MF, 1/4W, 1%, 511Ω	110-511-1
R48	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R49	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R50	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R51	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R52	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R53	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R54	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R55	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R56	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R57	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R58	Variable, 10-Turn, 500Ω	157-500
R59	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R62	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

R63	MF, 1/4W, 1%, 27.4 kΩ	110-27.4k-1
R64	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R65	Variable, 10-Turn, 500Ω	157-500
R66	Variable, 1-Turn, 500 kΩ	156-500k
R67	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R68	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R69	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R70	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R71	MF, 1/4W, 1%, 1.30 kΩ	110-1.30k-1
R72	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R73	MF, 1/4W, 1%, 3.40 kΩ	110-3.40k-1
R74	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R75	MF, 1/4W, 1%, 301Ω	110-301-1
R76	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R77	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R78	MF, 1/4W, 1%, 511Ω	110-511-1
R79	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R80	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R81	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R82	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R83	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R84	MF, 1/4W, 1%, 1M	110-1M-1
R85	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R87	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R88	Variable, 1-Turn, 20Ω	156-20
R89	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R90	MF, 1/4W, 1%, 31.6 kΩ	110-31.6k-1
R91	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R92	MF, 1/4W, 1%, 511Ω	110-511-1
R93	MF, 1/4W, 1%, 511Ω	110-511-1
R94	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R95	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R96	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R97	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R98	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R99	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R100	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad EX-OR Gate, 74LS86	54-125
U2	Quad Op Amp, TL074	54-132
U3	Quad Analog Switch, LF13201	54-20
U4	Op-Amp, OP05	54-87
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Dual Analog Switch, DG200	50-DG200BA
U8	Dual Op-Amp, TL072	54-53
U9	Quad Volt Comparator, MC3302P	54-MC3302P
U10	Input NAND Gate, 74LS10	54-42

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, P.C. Board	553-96
TP1 thru TP5	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-12. A6/A7/A8 YIG Driver, 8-12.4 GHz, 6621A/6629A/6637A/6638A/6647A/6648A (660-D-8009-4, -6, -7, -8, -99-90, -99-92)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF, 35V	250-19
C7	Tantalum, 1 µF, 35V	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41A
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 820 pF	220-820

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k

R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R7	Variable, 15-Turn, 1 kΩ	157-1k
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R10[5]	MF, 1/4W, 1%, 6.65 kΩ	110-6.65k-1
R10[6]	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R11[1]	MF, 1/4W, 1%, 10.5 kΩ	110-10.5k-1
R11[2]	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R11[3]	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R11[4]	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R14[5]	MF, 1/4W, 1%, 2.67 kΩ	110-2.67k-1
R14[6]	MF, 1/4W, 1%, 4.22 kΩ	110-4.22k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 5Ω	131-3
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R47	Variable, 15-Turn, 1 kΩ	157-1k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R55[5]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R55[6]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R56	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R56[5]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R57	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R57[5]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R57[6]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R58	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R58[5]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R58[6]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R59	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R59[5]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R59[6]	MF, 1/4W, 1%, 6.49Ω	110-6.49-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R61[2]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R61[3]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R61[4]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R62[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[2]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[3]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R62[4]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R62[5]	MF, 1/4W, 1%, 10.7 kΩ	110-10.7k-1
R62[6]	MF, 1/4W, 1%, 10.7 kΩ	110-10.7k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 866Ω	110-866-1
R67[2]	MF, 1/4W, 1%, 1.15 kΩ	110-1.15k-1
R67[3]	MF, 1/4W, 1%, 866Ω	110-866-1
R67[4]	MF, 1/4W, 1%, 1.15 kΩ	110-1.15k-1
R67[5]	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R67[6]	MF, 1/4W, 1%, 866Ω	110-866-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

---

[1] Used on 660-D-8009-4 assembly.
[2] Used on 660-D-8009-6 assembly.
[3] Used on 660-D-8009-7 assembly.
[4] Used on 660-D-8009-8 assembly.
[5] Used on 660-D-8009-99-90 assembly.
[6] Used on 660-D-8009-99-91 assembly.

Table 6-13. A6/A7 YIG Driver, 8-12.4 GHz, 6621A-40/6629A-40/6637A-40 (660-D-8009-14, -17, -99-91, -99-93)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39A
C2	Tantalum, 4.7 µF	250-39A
C3	Tantalum, 4.7 µF	250-39A
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Monolithic, .1 µF	230-37
C7	Monolithic, .1 µF	230-37
C8	Monolithic, 1.0 µF	230-41
C9	Not Used	
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C15	Not Used	
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 300 pF	220-300

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Not Used	
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A
Q8	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R6	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R7	Variable, 15-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11[1]	MF, 1/4W, 1%, 10.5 kΩ	110-10.5k-1
R11[2]	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R11[3]	MF, 1/4W, 1%, 6.65 kΩ	110-6.65k-1
R11[4]	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R14[3]	MF, 1/4W, 1%, 2.67 kΩ	110-2.67k-1
R14[4]	MF, 1/4W, 1%, 4.22 kΩ	110-4.22k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 5Ω	131-3
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1k	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R36	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R37	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R47	Variable, 15-Turn, 20 kΩ	157-20k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R56	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R57	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R58	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R59	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R61[2]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R61[3]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R61[4]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1

---

[1] Used on 660-D-8009-14 assembly.
[2] Used on 660-D-8009-17 assembly.
[3] Used on 660-D-8009-99-91 assembly.
[4] Used on 660-D-8009-99-93 assembly.

R62[2]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R62[3]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 866Ω	110-866-1
R67[2]	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-14. A6/A7/A8 YIG Driver, 12.4-18.6 GHz, 6629A-40/6637A-40 (660-D-8009-15, -16, -99-94)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39A
C2	Tantalum, 4.7 µF	250-39A
C3	Tantalum, 4.7 µF	250-39A
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Monolithic, .1 µF	230-37
C7	Monolithic, .1 µF	230-37
C8	Monolithic, 1.0 µF	230-41
C9	Not Used	
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C15	Not Used	
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 300 pF	220-300

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Not Used	
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A
Q8	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R6	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R7	Variable, 15-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1

---

[1] Used on 660-D-8009-14 assembly.
[2] Used on 660-D-8009-17 assembly.

R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11[1]	MF, 1/4W, 1%, 4.64 kΩ	110-4.64k-1
R11[2]	MF, 1/4W, 1%, 4.22 kΩ	110-4.22k-1
R11[3]	MF, 1/4W, 1%, 7.68 kΩ	110-7.68k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14[1]	MF, 1/4W, 1%, 1.91 kΩ	110-1.91k-1
R14[2]	MF, 1/4W, 1%, 2.74 kΩ	110-2.74k-1
R14[3]	MF,1 /4W, 1%, 3.16 kΩ	110-3.16k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 2Ω	131-1
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R36	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R37	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R40[3]	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R41[3]	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46[1]	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R46[2]	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R46[3]	MF, 1/4W, 1%, 8.45 kΩ	110-8.45k-1
R47	Variable, 15-Turn, 20 kΩ	157-20k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R56	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R57	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R58	MF, 1/4W, 1%, 8.66Ω	110-8.66-1

R59	MF, 1/4W, 1%, 8.66Ω	110-8.66-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61[1]	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R61[2]	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R61[3]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[3]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67[1]	MF, 1/4W, 1%, 866Ω	110-866-1
R67[2]	MF, 1/4W, 1%, 866Ω	110-866-1
R67[3]	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

---

[1] Used on 660-D-8009-15 assembly.
[2] Used on 660-D-8009-16 assembly
[3] Used on 660-D-8009-99-94 assembly.

Table 6-15. A7/A8 YIG Driver, 12.4-18.6 (20) GHz, 6629A/6637A/6638A/6647A/6648A (660-D-8008-4, -7, -99-90)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF, 35V	250-19
C7	Tantalum, 1 µF, 35V	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C15	Mica, 820 pF	220-820
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	NPN, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N2222A	20-2N2222A
Q7	PNP, 2N2907A	20-2N2907A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R6	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R7	Variable, 15-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10[1]	MF, 1/4W, 1%, 210 kΩ	110-210k-1
R10[2]	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11[1]	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R11[2]	MF, 1/4W, 1%, 7.68 kΩ	110-7.68k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14[1]	MF, 1/4W, 1%, 1.87 kΩ	110-1.87k-1
R14[2]	MF, 1/4W, 1%, 3.16 kΩ	110-3.16k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 3Ω	131-2
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1k	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R40	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R41[1]	MF, 1/4W, 1%, 110 kΩ	110-110k-1
R41[2]	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 8.45 kΩ	110-8.45k-1
R47	Variable, 15-Turn, 10 kΩ	157-10k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 8.06Ω	110-8.66-1
R56	MF, 1/4W, 1%, 8.06Ω	110-8.66-1
R57	MF, 1/4W, 1%, 8.06Ω	110-8.66-1
R58	MF, 1/4W, 1%, 8.06Ω	110-8.66-1
R59	CC, 1/2W, .5Ω	102-.5-5
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61[1]	MF, 1/4W, 1%, 110 kΩ	110-110k-1
R61[2]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[2]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1

---

[1] Used on 660-D-8008-4 and -7 assemblies.

[2] Used on 660-D-8008-99-90 assembly.

R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-16. A7 YIG Driver, 26.5-40 GHz, 6642A (660-D-8191-99-93)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 μF	250-39
C2	Tantalum, 4.7 μF	250-39
C3	Tantalum, 4.7 μF	250-39
C4	Disc Ceramic, .01 μF	230-11
C5	Disc Ceramic, .001 μF	230-30
C6	Tantalum, 1 μF, 35V	250-19
C7	Tantalum, 1 μF, 35V	250-19
C8	Monolithic, 1.0 μF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 μF	230-37
C11	Tantalum, 6.8 μF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 μF	230-37
C14	Disc Ceramic, .01 μF	230-11
C15	Mica, 820 pF	220-820
C16	Monolithic, .1 μF	230-37
C17	Disc Ceramic, .01 μF	230-11
C18	Disc Ceramic, .01 μF	230-11
C19	Disc Ceramic, .01 μF	230-11
C20	Mica, 39 pF	220-39

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N4249	20-2N4249
Q4	PNP, MPSU55	20-30
Q5	PNP, 2N2907A	20-2N2907A
Q6	NPN, 2N2222A	20-2N2222A
Q7	PNP, 2N2907A	20-2N2907A
Q8	PNP, 2N2907A	20-2N2907A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R6	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R7	Variable, 1-Turn, 1 kΩ	157-1k
R8	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R9	Variable, 1-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 162 kΩ	110-162k-1
R11	MF, 1/4W, 1%, 3.16 kΩ	110-3.16k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/4W, 1%, 2.05 kΩ	110-2.05k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1

R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 5Ω	131-3
R26	MF, 1/4W, 1%, 15.4 kΩ	110-15k-1
R27	MF, 1/4W, 1%, 649Ω	110-649-1
R28	MF, 1/4W, 1%, 6.19 kΩ	110-6.19k-1
R29	MF, 1/4W, 1%, 1.37 kΩ	110-1.37k-1
R30	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 500 kΩ	156-500k
R35	MF, 1/4W, 1%, 49.9 kΩ	110-49.9k-1
R36	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R37	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R40	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R41	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R42	Variable, 1-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 8.45 kΩ	110-8.45k-1
R47	Variable, 1-Turn, 10 kΩ	157-10k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R56	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R57	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R58	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R59	CC, 1/2W, 5%, .5Ω	102-.5-5
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61	MF, 1/4W, 1%, 511Ω	110-511-1
R62	MF, 1/4W, 1%, 12.1 kΩ	110-12.1k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 1-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R80	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R81	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R82	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R83	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	256 x 4 PROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-17. A7 YIG Driver, 8-12.4 GHz, 6653A/6659A (660-D-8009-9, -12)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF, 35V	250-19
C7	Tantalum, 1 µF, 35V	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 820 pF	220-820

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A

CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R7	Variable, 15-Turn, 1 kΩ	157-1k
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11[1]	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R11[2]	MF, 1/4W, 1%, 14 kΩ	110-14k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/4W, 1%, 2.61 kΩ	110-2.61k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 5Ω	131-3
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R47	Variable, 15-Turn, 1 kΩ	157-1k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R56	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R57	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R58	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R59	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R61[2]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R62[1]	MF, 1/4W, 1%, 33.2 kΩ	110-33.2k-1
R62[2]	MF, 1/4W, 1%, 38.3 kΩ	110-38.3k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 2.26 kΩ	110-2.26k-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

---

[1] Used on 660-D-8009-9 assembly.

[2] Used on 660-D-8009-12 assembly.

Table 6-18. A8 YIG Driver, 12.4-18.6 GHz, 6653A/6659A (660-D-8009-10, -13)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF, 35V	250-19
C7	Tantalum, 1 µF, 35V	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41A
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 820 pF	220-820

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R7	Variable, 15-Turn, 1 kΩ	157-1k
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11[1]	MF, 1/4W, 1%, 6.19 kΩ	110-6.19k-1
R11[2]	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14[1]	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R14[2]	MF, 1/4W, 1%, 1.87 kΩ	110-1.87k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 2Ω	131-1
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R47	Variable, 15-Turn, 1 kΩ	157-1k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R56	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R57	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R58	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R59	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 825Ω	110-825-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20

---

[1] Used on 660-D-8009-10 assembly.

[2] Used on 660-D-8009-13 assembly.

R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-19. A9 YIG Driver, 18-26.5 GHz, 6653A/6659A (660-D-8009-11)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 4.7 µF	250-39
C2	Tantalum, 4.7 µF	250-39
C3	Tantalum, 4.7 µF	250-39
C4	Disc Ceramic, .01 µF	230-11
C5	Disc Ceramic, .001 µF	230-30
C6	Tantalum, 1 µF, 35V	250-19
C7	Tantalum, 1 µF, 35V	250-19
C8	Monolithic, 1.0 µF	230-41
C9	Mica, 300 pF	220-300
C10	Monolithic, .1 µF	230-37
C11	Tantalum, 6.8 µF	250-41A
C12	Mica, 5 pF	220-5
C13	Monolithic, .1 µF	230-37
C14	Disc Ceramic, .01 µF	230-11
C16	Monolithic, .1 µF	230-37
C17	Disc Ceramic, .01 µF	230-11
C18	Disc Ceramic, .01 µF	230-11
C19	Disc Ceramic, .01 µF	230-11
C20	Mica, 820 pF	220-820

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, SI2	10-SI2
CR4	Zener, 24V, 1W, 1N4749A	10-1N4749A
CR5	Silicon, SI2	10-SI2
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 10V, 0.4W, 1N758A	10-1N758A
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MPSA92	20-MPSA92
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, 2N3694	20-2N3694
Q4	NPN, 2N2222A	20-2N2222A
Q5	NPN, 2N2222A	20-2N2222A
Q6	PNP, 2N2907A	20-2N2907A
Q7	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	CC, 1/4W, 5%, 3.3 MΩ	101-3.3M-5
R2	Variable, 15-Turn, 50 kΩ	157-50k
R3	CC, 1/4W, 5%, 3.6 MΩ	101-3.6M-5
R4	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R5	Variable, 15-Turn, 1 kΩ	157-1k
R7	Variable, 15-Turn, 1 kΩ	157-1k
R9	Variable, 15-Turn, 200 kΩ	157-200k
R10	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R11	MF, 1/4W, 1%, 4.02 kΩ	110-4.02k-1
R12	MF, 1/4W, 1%, 20 kΩ	110-20k-1
R13	Variable, 1-Turn, 20 kΩ	156-20k
R14	MF, 1/4W, 1%, 1.54 kΩ	110-1.54k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 23.7 kΩ	110-23.7k-1
R19	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R20	MF, 1/4W, 1%, 121Ω	110-121-1
R21	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R22	MF, 1/4W, 1%, 7.5 kΩ	110-7.5k-1
R23	MF, 1/4W, 1%, 511Ω	110-511-1
R24	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R25	WW, 5W, 2Ω	131-1
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1

R27	MF, 1/4W, 1%, 750Ω	110-750-1
R28	MF, 1/4W, 1%, 5.49 kΩ	110-5.49k-1
R29	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R30	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R31	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R32	MF, 1/4W, 1%, 1.21 kΩ	110-1.21k-1
R33	MF, 1/4W, 1%, 17.8 kΩ	110-17.8k-1
R34	Variable, 1-Turn, 200 kΩ	156-200k
R35	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R38	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R39	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R42	Variable, 15-Turn, 50 kΩ	157-50k
R43	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R44	MF, 1/4W, 1%, 18.7 kΩ	110-18.7k-1
R45	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R46	MF, 1/4W, 1%, 9.53 kΩ	110-9.53k-1
R47	Variable, 15-Turn, 1 kΩ	157-1k
R48	MF, 1/4W, 1%, 11 kΩ	110-11k-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 511Ω	110-511-1
R51	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R52	MF, 1/4W, 1%, 3.83 kΩ	110-3.83k-1
R53	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R54	MF, 1/4W, 1%, 511Ω	110-511-1
R55	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R56	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R57	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R58	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R59	MF, 1/4W, 1%, 6.19Ω	110-6.19-1
R60	MF, 1/4W, 1%, 2.15 kΩ	110-2.15k-1
R61	MF, 1/4W, 1%, 12.1 kΩ	110-12.1k-1
R63	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R64	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R65	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R66	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R67	MF, 1/4W, 1%, 5.11Ω	110-5.11-1
R68	Variable, 15-Turn, 500Ω	157-500
R69	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 750 kΩ	110-750k-1
R72	MF, 1/4W, 1%, 14.7 kΩ	110-14.7k-1
R73	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 205 kΩ	110-205k-1
R76	MF, 1/4W, 1%, 511Ω	110-511-1
R77	Variable, 1-Turn, 20Ω	156-20
R78	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R79	MF, 1/4W, 1%, 15 kΩ	110-15k-1
R80	MF, 1/4W, 1%, 511Ω	110-511-1
R81	MF, 1/4W, 1%, 511Ω	110-511-1
R82	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R83	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R84	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R85	MF, 1/4W, 1%, 5.11 kΩ	110-5.11k-1
R86	MF, 1/4W, 1%, 5.11Ω	110-5.11-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Analog Switch, LF13201	54-20
U2	NAND Gate, 74LS10	54-42
U3	Op Amp, OP05	54-87
U4	Quad Op Amp, TL072	54-53
U5	2k x 8 EPROM	Not Field-Replaceable
U7	Quad Op Amp, TL074	54-132
U8	Quad Ex. OR Gate, 74LS86	54-125
U9	Dual Volt. Comp., LM393	54-158

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Ejector, PC Board	553-96
TP1 thru TP4	Pin, Test Point	706-44
K1	Relay, 2 Form C	690-28
---	Socket, I.C., 24-Pin	553-67

Table 6-20. A10 FM/Attenuator (660-D-8010)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Mica, 130 pF	220-130
C2	Monolithic, .1 µF	230-37
C3	Monolithic, .1 µF	230-37
C4	Monolithic, .1 µF	230-37
C5	Monolithic, .1 µF	230-37
C6	Monolithic, .1 µF	230-37
C7[1]	Monolithic, .1 µF	230-37
C8	Mica, 8 pF	220-8
C9	Tantalum, 25V, 10 µF	250-42
C10	Tantalum, 25V, 10 µF	250-42
C11	Ceramic Disc, .001 µF	230-30
C12	Mica, 8 pF	220-8
C13	Monolithic, .1 µF	230-37
C14	Monolithic, .1 µF	230-37
C15	Mica, 8 pF	220-8
C16	Mica, 8 pF	220-8
C17	Tantalum, 25V, 10 µF	250-42
C18	Tantalum, 25V, 10 µF	250-42
C19	Tantalum, 25V, 10 µF	250-42
C20	Tantalum, 25V, 10 µF	250-42
C21	Monolithic, .1 µF	230-37
C22	Monolithic, .1 µF	230-37
C23	Tantalum, 6V, 68 µF	250-58
C24	Ceramic Disc .01 µF	230-11
C25	Ceramic Disc .01 µF	230-11
C26	Mica, 8 pF	220-8
C27	Tantalum, 25V, 10 µF	250-42
C28	Tantalum, 25V, 10 µF	250-42
C29	Ceramic, .0047 µF	230-36
C30	Mica, 8 pF	220-8

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Zener, 3.3V, 0.4W, 1N746A	10-1N746A
CR4	Zener, 3.3V, 0.4W, 1N746A	10-1N746A

---

[1] .01 µF, 230-11, 6637A-40 only.

CR5	Silicon, 1N4446	10-1N4446
CR6	Silicon, 1N4446	10-1N4446
CR7	Zener, 3.3V, 0.4W, 1N746A	10-1N746A
CR8	Zener, 3.3V, 0.4W, 1N746A	10-1N746A
CR9	Silicon, 1N4446	10-1N4446
CR10	Silicon, 1N4446	10-1N4446
CR11	Silicon, 1N4446	10-1N4446
CR12	Silicon, 1N4446	10-1N4446
CR13	Silicon, 1N4446	10-1N4446
CR14	Zener, 4.7V, 0.4W, 1N750A	10-11
CR15	Zener, 4.7V, 0.4W, 1N750A	10-11
CR16	Silicon, 1N4446	10-1N4446
CR17	Silicon, 1N4446	10-1N4446
CR18	Silicon, 1N4446	10-1N4446
CR19	Silicon, 1N4446	10-1N4446
CR20	Silicon, 1N4446	10-1N4446
CR21	Silicon, 1N4446	10-1N4446
CR22	Silicon, 1N4446	10-1N4446
CR23	Silicon, 1N4446	10-1N4446
CR24	Silicon, 1N4446	10-1N4446
CR25	Silicon, 1N4446	10-1N4446
CR26	Silicon, 1N4446	10-1N4446
CR27	Silicon, 1N4446	10-1N4446
CR28	Silicon, 1N4446	10-1N4446
CR29	Silicon, 1N4446	10-1N4446
CR30	Silicon, 1N4446	10-1N4446
CR31	Silicon, 1N4446	10-1N4446
CR32	Silicon, 1N4446	10-1N4446

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, 10W, 2N6552	20-3
Q2	NPN, 10W, 2N6555	20-4
Q3	PNP, 10W, 2N6552	20-3
Q4	NPN, 10W, 2N6555	20-4
Q5	NPN, 50W, TIP110	20-22
Q6	PNP, 50W, TIP115	20-23

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 14.3 kΩ	110-14.3k-1
R2	MF, 1/4W, 1%, 14.3 kΩ	110-14.3k-1
R3	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R4	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R5	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R6	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R7	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R8	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R9	MF, 1/4W, 1%, 1 kΩ	110-1k-1
R10	Variable, 5k, 1-Turn	156-5k
R11	Variable, 5k, 1-Turn	156-5k
R12	Variable, 5k, 1-Turn	156-5k
R13	Variable, 5k, 1-Turn	156-5k
R14	MF, 1/4W, 1%, 7.32 kΩ	110-7.32k-1
R15	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R16	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R17	MF, 1/4W, 1%, 100Ω	110-100-1
R18	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R19	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R20	MF, 1/4W, 1%, 16.5 kΩ	110-16.5k-1
R21	Not Used	
R22	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R23	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R24	MF, 1/4W, 1%, 100 kΩ	110-100k-1
R25	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 8.87 kΩ	110-8.87k-1
R28	MF, 1/4W, 1%, 49.9 kΩ	110-49.9-1
R29	MF, 1/4W, 1%, 2.8 kΩ	110-2.8k-1
R30	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R31	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R32	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R33	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R34	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R35	MF, 1/4W, 1%, 14.7Ω	110-14.7-1
R36	MF, 1/4W, 1%, 2.8 kΩ	110-2.8k-1
R37	MF, 1/4W, 1%, 42.2Ω	110-42.2-1
R38	MF, 1/4W, 1%, 42.2Ω	110-42.2-1
R39	MF, 1/4W, 1%, 42.2Ω	110-42.2-1
R40	MF, 1/4W, 1%, 42.2Ω	110-42.2-1
R41	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R42	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R43	MF, 1/4W, 1%, 3.65 kΩ	110-3.65k-1
R44	MF, 1/4W, 1%, 80.6Ω	110-80.6-1
R45	MF, 1/4W, 1%, 80.6Ω	110-80.6-1
R46	MF, 1/4W, 1%, 34.8Ω	110-34.8-1
R47	MF, 1/4W, 1%, 34.8Ω	110-34.8-1
R48	MF, 1/4W, 1%, 34.8Ω	110-34.8-1
R49	MF, 1/4W, 1%, 34.8Ω	110-34.8-1
R50	MF, 1/4W, 1%, 3.65 kΩ	110-3.65k-1
R51	MF, 1/4W, 1%, 121Ω	110-121-1
R52	MF, 1/4W, 1%, 121Ω	110-121-1
R53	MF, 1/4W, 1%, 121Ω	110-121-1
R54	MF, 1/4W, 1%, 121Ω	110-121-1
R55	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R56	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R57	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R58	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R59	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R60	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R61	Variable, 10k, 1-Turn	156-10k
R62	Variable, 10k, 1-Turn	156-10k
R63	MF, 1/4W, 1%, 46.4 kΩ	110-46.4k-1
R64	MF, 1/4W, 1%, 8.25 kΩ	110-8.25k-1
R65	MF, 1/4W, 1%, 100Ω	110-100-1
R66	MF, 1/4W, 1%, 3.65 kΩ	110-3.65k-1
R67	MF, 1/4W, 1%, 3.65 kΩ	110-3.65k-1
R68	WW, 3W, 5Ω	130-5-3
R69	WW, 3W, 5Ω	130-5-3
R70	WW, 3W, 5Ω	130-5-3
R71	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R72	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R73	MF, 1/4W, 1%, 9.76 kΩ	110-9.76k-1
R74	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R75	MF, 1/4W, 1%, 8.82 kΩ	110-8.82k-1

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Quad Exclusive OR 74LS86	54-125
U2	Comparator, LM311H	54-30
U3	Comparator, LM311H	54-30
U4	Op Amp, LF357	50-7
U5	Quad Switch DG201CJ	54-24

U6	Quad Switch DG201CJ	54-24
U7	Op Amp, LF357	50-7
U8	Op Amp, LF357	50-7
U9	Op Amp, LF357	50-7
U10	Op Amp, LF357	50-7
U11	Hex Inverter, 74LS04	54-74LS04
U12	Dual AND Driver, 75451	54-144
U13	Dual AND Driver, 75451	54-144
U14	Dual AND Driver, 75451	54-144
U15	Dual AND Driver, 75451	54-144

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
TP1 thru TP6	Pin, Test Point	706-44
——	Heatsink, Transistor #6030	553-53
——	Ejector, P.C. Board	553-96

Table 6-21. A11 Front Panel (660-D-8011)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Electrolytic, 250 µF, 25V	250-53
C2	Monolithic, 0.1 µF, 50V	230-37
C3	Monolithic, 0.1 µF, 50V	230-37
C4	Monolithic, 0.1 µF, 50V	230-37
C5	Monolithic, 0.1 µF, 50V	230-37
C6	Monolithic, 0.1 µF, 50V	230-37
C7	Monolithic, 0.1 µF, 50V	230-37
C8	Monolithic, 0.1 µF, 50V	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
DS1	Light Emitting, Red	15-5
DS2	Light Emitting, Red	15-5
DS3	Light Emitting, Red	15-5
DS4	Light Emitting, Red	15-5
DS5	Light Emitting, Red	15-5
DS6	Light Emitting, Red	15-5
DS7	Light Emitting, Red	15-5
DS8	Light Emitting, Red	15-5
DS9	Not Used	
DS10	Light Emitting, Red	15-5
DS11	Light Emitting, Red	15-5
DS12	Not Used	
DS13	Light Emitting, Red	15-5
DS14	Not Used	
DS15	Not Used	
DS16	Light Emitting, Yellow	15-7
DS17	Not Used	
DS18	Light Emitting, Red	15-5
DS19	Light Emitting, Yellow	15-7
DS20	Light Emitting, Yellow	15-7
DS21	Light Emitting, Yellow	15-7
DS22	Light Emitting, Yellow	15-7
DS23	Light Emitting, Yellow	15-7
DS24	Light Emitting, Yellow	15-7
DS25	Light Emitting, Yellow	15-7
DS26	Light Emitting, Yellow	15-7
DS27	Light Emitting, Yellow	15-7
DS28	Light Emitting, Yellow	15-7
DS29	Light Emitting, Yellow	15-7
DS30	Light Emitting, Yellow	15-7
DS31	Light Emitting, Yellow	15-7
DS32	Light Emitting, Yellow	15-7
DS33	Light Emitting, Yellow	15-7
DS34	Not Used	
DS35	Light Emitting, Red	15-5
DS36	Light Emitting, Yellow	15-7
DS37	Light Emitting, Yellow	15-7
DS38	Light Emitting, Yellow	15-7
DS39	Light Emitting, Yellow	15-7
DS40	Light Emitting, Yellow	15-7
DS41	Light Emitting, Yellow	15-7
DS42	Light Emitting, Yellow	15-7
DS43	Light Emitting, Yellow	15-7
DS44	Light Emitting, Yellow	15-7
DS45	Light Emitting, Yellow	15-7
DS46	Light Emitting, Yellow	15-7
DS47	Light Emitting, Yellow	15-7
DS48	Display, 7-Segment, LED	15-15
DS49	Display, 7-Segment, LED	15-15
DS50	Display, 7-Segment, LED	15-15
DS51	Display, 7-Segment, LED	15-15
DS52	Display, 7-Segment, LED	15-15
DS53	Display, 7-Segment, LED	15-15
DS54	Display, 7-Segment, LED	15-15
DS55	Display, 7-Segment, LED	15-15
DS56	Display, 7-Segment, LED	15-15
DS57	Display, 7-Segment, LED	15-15
DS58	Display, +/- 1, LED	15-14
DS59	Display, 7-Segment, LED	15-15
DS60	Display, 7-Segment, LED	15-15
DS61	Display, 7-Segment, LED	15-15
DS62	Display, 7-Segment, LED	15-15
DS63	Light Emitting, Red	15-5
DS64	Light Emitting, Red	15-5
DS65	Light Emitting, Yellow	15-7
DS66	Light Emitting, Yellow	15-7
DS67	Light Emitting, Yellow	15-7
DS68	Light Emitting, Yellow	15-7
DS69	Light Emitting, Yellow	15-7
DS70	Light Emitting, Yellow	15-7
DS71	Light Emitting, Yellow	15-7
DS72	Light Emitting, Yellow	15-7
DS73	Light Emitting, Red	15-5

CONNECTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
J1	20 Pin, SIP, Female	551-173
J2	20 Pin, SIP, Female	551-173
J3	20 Pin, SIP, Female	551-173
J4	20 Pin, SIP, Female	551-173

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, 2N2907	20-2N2907
Q2	PNP, 2N2907	20-2N2907

Q3	PNP, 2N2907	20-2N2907
Q4	PNP, 2N2907	20-2N2907
Q5	PNP, 2N2907	20-2N2907
Q6	PNP, 2N2907	20-2N2907
Q7	PNP, 2N2907	20-2N2907
Q8	PNP, 2N2907	20-2N2907
Q9	PNP, 2N2907	20-2N2907
Q10	PNP, 2N2907	20-2N2907
Q11	PNP, 2N2907	20-2N2907
Q12	PNP, 2N2907	20-2N2907
Q13	PNP, 2N2907	20-2N2907
Q14	PNP, 2N2907	20-2N2907
Q15	PNP, 2N2907	20-2N2907

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 215Ω	110-215-1
R2	MF, 1/4W, 1%, 215Ω	110-215-1
R3	MF, 1/4W, 1%, 215Ω	110-215-1
R4	Not Used	
R5	MF, 1/4W, 1%, 215Ω	110-215-1
R6	MF, 1/4W, 1%, 215Ω	110-215-1
R7	MF, 1/4W, 1%, 215Ω	110-215-1
R8	Not Used	
R9	MF, 1/4W, 1%, 215Ω	110-215-1
R10	MF, 1/4W, 1%, 215Ω	110-215-1
R11	MF, 1/4W, 1%, 215Ω	110-215-1
R12	MF, 1/4W, 1%, 215Ω	110-215-1
R13	MF, 1/4W, 1%, 215Ω	110-215-1
R14	MF, 1/4W, 1%, 215Ω	110-215-1
R15	MF, 1/4W, 1%, 215Ω	110-215-1
R16	MF, 1/4W, 1%, 215Ω	110-215-1
R17	MF, 1/4W, 1%, 215Ω	110-215-1
R18	MF, 1/4W, 1%, 215Ω	110-215-1
R19	Not Used	
R20	MF, 1/4W, 1%, 215Ω	110-215-1
R21	MF, 1/4W, 1%, 215Ω	110-215-1
R22	MF, 1/4W, 1%, 215Ω	110-215-1
R23	MF, 1/4W, 1%, 215Ω	110-215-1
R24	MF, 1/4W, 1%, 147Ω	110-147-1
R25	MF, 1/4W, 1%, 147Ω	110-147-1
R26	MF, 1/4W, 1%, 147Ω	110-147-1
R27	MF, 1/4W, 1%, 147Ω	110-147-1
R28	MF, 1/4W, 1%, 147Ω	110-147-1
R29	MF, 1/4W, 1%, 147Ω	110-147-1
R30	MF, 1/4W, 1%, 147Ω	110-147-1
R31	MF, 1/4W, 1%, 147Ω	110-147-1
R32	MF, 1/4W, 1%, 215Ω	110-215-1
R33	MF, 1/4W, 1%, 4.64k	110-4.64k-1
R34	MF, 1/4W, 1%, 215Ω	110-215-1
R35	MF, 1/4W, 1%, 215Ω	110-215-1
R36	MF, 1/4W, 1%, 215Ω	110-215-1
R37	MF, 1/4W, 1%, 215Ω	110-215-1
R38	MF, 1/4W, 1%, 10k	110-10k-1
R39	Not Used	
R40	Variable, 20k	146-3
R41	Variable, 20k	146-3
R42	Not Used	
R43	Variable, 20k	146-5
RP1	DIP, 56Ω	123-11
RP2	DIP, 220Ω	123-12
RP3	DIP, 220Ω	123-12
RP4	DIP, 220Ω	123-13
RP5	SIP, 220Ω	123-14
RP6	SIP, 220Ω	123-14
RP7	SIP, 4.7k	123-15
RP8	SIP, 4.7k	123-15

SWITCHES

REF. DES.	DESCRIPTION	WILTRON PART NO.
S1	SPST, Momentary	430-130
S2	SPST, Momentary	430-130
S3	SPST, Momentary	430-130
S4	SPST, Momentary	430-130
S5	SPST, Momentary	430-130
S6	SPST, Momentary	430-130
S7	SPST, Momentary	430-130
S8	SPST, Momentary	430-130
S9	SPST, Momentary	430-130
S10	SPST, Momentary	430-130
S11	SPST, Momentary	430-130
S12	SPST, Momentary	430-130
S13	DPST, Momentary	430-131
S14	DPST, Momentary	430-131
S15	SPST, Momentary	430-130
S16	SPST, Momentary	430-130
S17	DPST, Momentary	430-131
S18	SPST, Momentary	430-130
S19	SPST, Momentary	430-130
S20	Not Used	
S21	Not Used	
S22	SPST, Momentary	430-130
S23	SPST, Momentary	430-130
S24	SPST, Momentary	430-130
S25	SPST, Momentary	430-130
S26	Not Used	
S27	SPST, Momentary	430-130
S28	SPST, Momentary	430-130
S29	SPST, Momentary	430-130
S30	SPST, Momentary	430-130
S31	SPST, Momentary	430-130
S32	SPST, Momentary	430-130
S33	SPST, Momentary	430-130
S34	SPST, Momentary	430-130
S35	SPST, Momentary	430-130
S36	SPST, Momentary	430-130
S37	DPST, Momentary	430-131
S38	DPST, Momentary	430-131
S39	SPST, Momentary	430-130
S40	Not Used	
S41	Not Used	
S42	SPST, Momentary	430-130
S43	SPST, Momentary	430-130
S44	SPST, Momentary	430-130
S45	SPST, Momentary	430-130
S46	SPST, Momentary	430-130
S47	SPST, Momentary	430-130
S48	SPST, Momentary	430-130
S49	SPST, Momentary	430-130
S50	SPST, Momentary	430-130
S51	SPST, Momentary	430-130
S52	SPST, Momentary	430-130
S53	SPST, Momentary	430-130
S54	DPST, Momentary	430-131
S55	SPST, Momentary	430-130
S56	SPST, Momentary	430-130
S57	SPST, Momentary	430-130
S58	SPST, Momentary	430-130

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	74LS374, Octal Latch	54-41
U2	74LS374, Octal Latch	54-41

U3	74LS374, Octal Latch	54-41
U4	74LS374, Octal Latch	54-41
U5	74LS374, Octal Latch	54-41
U6	74LS374, Octal Latch	54-41
U7	74LS138, 3 to 8 Decoder	54-74LS138
U8	7406, HEX Inverter	54-104
U9	7406, HEX Inverter	54-104
U10	7406, HEX Inverter	54-104
U11	74154, 4 to 16 Decoder	54-147

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
——	Socket, DIP, 14 Pin	551-143
——	Standoff, Nylon (Long LED)	790-129
——	Standoff, Nylon (Short LED)	790-130
——	Standoff, Nylon (Display LED)	790-131

Table 6-22. A12 Microprocessor (660-D-8012)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Tantalum, 10 µF, 25V	250-42
C2	Tantalum, 10 µF, 25V	250-42
C3	Mylar, 0.047 µF, 250V	210-28
C4	Tantalum, 1 µF, 35V	250-19
C5	Disc Ceramic, 0.01 µF, 100V	230-11
C6	Mylar, 0.1 µF, 250V	210-30
C7	Disc Ceramic, 0.01 µF, 100V	230-11
C8	Disc Ceramic, 0.01 µF, 100V	230-11
C9	Disc Ceramic, 0.01 µF, 100V	230-11
C10	Monolithic, 0.1 µF, 50V	230-37
C11	Monolithic, 0.1 µF, 50V	230-37
C12	Monolithic, 0.1 µF, 50V	230-37
C13	Monolithic, 0.1 µF, 50V	230-37
C14	Monolithic, 0.1 µF, 50V	230-37
C15	Monolithic, 0.1 µF, 50V	230-37
C16	Monolithic, 0.1 µF, 50V	230-37
C17	Monolithic, 0.1 µF, 50V	230-37
C18	Monolithic, 0.1 µF, 50V	230-37
C19	Monolithic, 0.1 µF, 50V	230-37
C20	Monolithic, 0.1 µF, 50V	230-37
C22	Monolithic, 0.1 µF, 50V	230-37

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon Rectifier, SI2	10-SI2
CR2	1N4446	10-1N4446
CR3	1N4446	10-1N4446
CR4	1N4446	10-1N4446
CR5	1N4446	10-1N4446
CR6	1N4446	10-1N4446

CONNECTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
P1	20 Pin, Male	551-215
P2	20 Pin, Male	551-215
P3	20 Pin, Male	551-215
P4	20 Pin, Male	551-215
P5	26 Pin, Male	551-102
P6	26 Pin, Male	551-102
P7	26 Pin, Male	551-102
P8	3 Pin, Male	551-207
P9	Plug, DIP, 18 Pin	551-236

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, MJE371	20-24
Q2	NPN, 2N2222A	20-2N2222A
Q3	NPN, 2N2222A	20-2N2222A
Q4	NPN, 2N2222A	20-2N2222A

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 12.1k	110-12.1k-1
R2	MF, 1/4W, 1%, 150Ω	110-150-1
R3	MF, 1/4W, 1%, 46.4k	110-46.4k-1
R4	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R5	MF, 1/4W, 1%, 68.1k	110-68.1k-1
R6	MF, 1/4W, 1%, 237k	110-237k-1
R7	MF, 1/4W, 1%, 100k	110-100k-1
R8	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R9	MF, 1/4W, 1%, 100k	110-100k-1
R10	MF, 1/4W, 1%, 1M	110-1M-1A
R11	CC, 1/2W, 5%, 430Ω	102-430-5
R12	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R13	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R14	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R15	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R16	MF, 1/4W, 1%, 100k	110-100k-1
R17	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R18	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R19	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R20	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R21	MF, 1/4W, 1%, 100k	110-100k-1
R22	MF, 1/4W, 1%, 100k	110-100k-1
R23	MF, 1/4W, 1%, 100k	110-100k-1
R24	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R25	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R26	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R27	MF, 1/4W, 1%, 100k	110-100k-1
R28	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R29	MF, 1/4W, 1%, 215Ω	110-215-1
R30	MF, 1/4W, 1%, 215Ω	110-215-1
R31	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R32	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R33	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R34	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R35	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R36	MF, 1/4W, 1%, 82.5k	110-82.5k-1
R37	MF, 1/4W, 1%, 31.6k	110-31.6k-1
R38	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R39	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R40	MF, 1/4W, 1%, 10 kΩ	110-10k-1

R41	MF, 1/4W, 1%, 20k	110-20k-1
R42	MF, 1/4W, 1%, 20k	110-20k-1
R43	MF, 1/4W, 1%, 31.6k	110-31.6k-1
R44	MF, 1/4W, 1%, 100k	110-100k-1
R45	MF, 1/4W, 1%, 20k	110-20k-1
R46	Variable, Single-Turn, 10k	156-10k
R47	MF, 1/4W, 1%, 20k	110-20k-1
R48	MF, 1/4W, 1%, 100Ω	110-100-1
R49	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R50	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R51	MF, 1/4W, 1%, 1k	110-1k-1
R52	MF, 1/4W, 1%, 10 kΩ	110-10k-1
RP1	SIP, 10k	123-6
RP2	DIP, 100k	123-10

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Micropower Comparator	54-151
U2	8085A, Microprocessor	54-93
U3	74LS373, Octal Latch	54-103
U4	74LS138, Decoder	54-74LS138
U5	2716, 2k x 8 EPROM	Contact WILTRON Customer Service
U6	2716, 2k x 8 EPROM	
U7	2716, 2k x 8 EPROM	
U8	2716, 2k x 8 EPROM	
U9	Not Used	
U10	74LS244, Octal Tri-state Driver	54-143
U11	5101L-1, 256x4 CMOS RAM	54-146
U12	5101L-1, 256x4 CMOS RAM	54-146
U13	DP8304B, Bidirectional Bus Driver	54-128
U14	DP8304B, Bidirectional Bus Driver	54-128
U15	74LS04, HEX Inverter	54-74LS04
U16	74LS01, Quad NAND Gate	54-74LS01
U17	Not Used	
U18	74LS138, Decoder	54-74LS138
U19	74LS138, Decoder	54-74LS138
U20	74LS138, Decoder	54-74LS138
U21	74LS138, Decoder	54-74LS138
U22	74LS138, Decoder	54-74LS138
U23	74LS138, Decoder	54-74LS138
U24	74LS30, 8-input NAND	54-58
U25	8279-5, Keyboard/Display Interface	54-97
U26	96L02, Dual Monostable	54-96L02
U27	555, Timer	54-555
U28	74LS161, 4-Bit Binary Counter	54-60
U29	74LS374, Octal Latch	54-41
U30	74LS374, Octal Latch	54-41
U31	74LS374, Octal Latch	54-41
U32	74LS04, HEX Inverter	54-74LS04
U33	74LS04, HEX Inverter	54-74LS04
U34	74LS02, Quad 2-Input NOR	54-57
U35	74LS02, Quad 2-Input NOR	54-57
U36	TL072, Dual Op Amp	54-53
U37	5101L-1, 256 x 4 CMOS RAM	54-146
U38	5101L-1, 256 x 4 CMOS RAM	54-146

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
B1	Battery, 2.4V	633-8
S1	Switch, Slide, SPDT	420-14
Y1	Crystal, 6.000 MHz	630-17
----	Socket, 20 Pin DIP	553-98
----	Socket, 24 Pin DIP	553-67
----	Socket, 40 Pin DIP	553-66
TP1 thru TP27	Pin, Test Point	706-44

Table 6-23. A13 Switching Power Supply (660-D-8013)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Monolithic, .1 μF, 50V	230-37
C2	Tantalum, 1 μF, 35V	250-19
C3	Tantalum, 10 μF, 25V	250-42
C4	Monolithic, .1 μF, 50V	230-37
C5	Mylar, 1000 pF, 500V, 5%	227-13
C6	Tantalum, 10 μF, 25V	250-42
C7	Tantalum, 2.2 μF, 20V	250-40
C8	Tantalum, 4.7 μF, 35V	250-39
C9	Mylar, .01 μF, 200V	210-20
C10	Monolithic, .1 μF, 50V	230-37
C11	Mylar, 1000 pF, 500V, 5%	227-13
C12	Monolithic, .1 μF, 50V	230-37
C13	Tantalum, 10 μF, 25V	250-42
C14	Tantalum, 12 μF, 350V	250-85
C15	Tantalum, 12 μF, 350V	250-85
C16	Mica, 470 pF	220-470
C17	Disc., .0027 μF, 100V	230-34
C18	Disc., .0027 μF, 100V	230-34
C19	Tantalum, 6.8 μF, 35V	250-41A
C20	Electrolytic, 150 μF, 25V	250-52
C21	Electrolytic, 150 μF, 25V	250-52
C22	Tantalum, 6.8 μF, 35V	250-41A
C23	Tantalum, 6.8 μF, 35V	250-41A
C24	Disc., .0027 μF, 100V	230-34
C25	Disc., .0027 μF, 100V	230-34
C26	Tantalum, 6.8 μF, 35V	250-41A
C27	Electrolytic, 150 μF, 25V	250-52
C28	Electrolytic, 150 μF, 25V	250-52
C29	Tantalum, 6.8 μF, 35V	250-41A
C30	Tantalum, 6.8 μF, 35V	250-41A
C31	Tantalum, 6.8 μF, 35V	250-41A
C32	Tantalum, 6.8 μF, 35V	250-41A
C33	Electrolytic, 47 μF, 63V	250-51
C34	Disc., .0027 μF, 100V	230-34
C35	Tantalum, 6.8 μF, 35V	250-41A
C36	Disc., .002 μF, 500V	230-33
C37	Disc., .002 μF, 500V	230-33
C38	Tantalum, 6.8 μF, 35V	250-41A
C39	Mylar, .1 μF, 250V	210-30
C40	Electrolytic, 47 μF, 63V	250-51
C41	Tantalum, 6.8 μF, 35V	250-41A
C42	Disc., .002 μF, 500V	230-33
C43	Disc., .002 μF, 500V	230-33
C44	Tantalum, 6.8 μF, 35V	250-41A
C45	Mylar, .1 μF, 250V	210-30
C46	Electrolytic, 47 μF, 63V	250-51
C47	Tantalum, 6.8 μF, 35V	250-41A
C48	Monolithic, .1 μF, 50V	230-37
C49	Mica, 15 pF	220-15

C50	Disc, Ceramic, .01 µF, 1kV	230-40
C51	Disc, Ceramic, .01 µF, 1kV	230-40
C52	Tantalum, .0047 µF, 3kV	250-97
C53	Tantalum, .0047 µF, 3kV	250-97

DIODES

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Silicon, 1N4446	10-1N4446
CR2	Silicon, 1N4446	10-1N4446
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, 1N4446	10-1N4446
CR5	Silicon, 1N4446	10-1N4446
CR6	Silicon, 1N4446	10-1N4446
CR7	Silicon, 1N4446	10-1N4446
CR8	Silicon, 1N4446	10-1N4446
CR9	Zener, 15V, 1W, 5%, 1N4744A	10-1N4744A
CR10	Silicon, 1N4446	10-1N4446
CR11	Fast Recovery, 400V, 1A, 1N4936	10-23
CR12	Fast Recovery, 400V, 1A, 1N4936	10-23
CR13	Schottky, 40V, 5A, 1N5825	10-22
CR14	Schottky, 40V, 5A, 1N5825	10-22
CR15	Zener, 25V, 5W, 5%, 1N5360A	10-24
CR16	Fast Recovery, 100V, 3A, MR851	10-27
CR17	Fast Recovery, 100V, 3A, MR851	10-27
CR18	Fast Recovery, 100V, 3A, MR851	10-27
CR19	Fast Recovery, 100V, 3A, MR851	10-27
CR20	Fast Recovery, 200V, 3A, MR852	10-26
CR21	Fast Recovery, 200V, 3A, MR852	10-26
CR22	Fast Recovery, 200V, 3A, MR852	10-26
CR23	Fast Recovery, 200V, 3A, MR852	10-26
CR24	Fast Recovery, 200V, 3A, MR852	10-26
CR25	Fast Recovery, 200V, 3A, MR852	10-26
CR26	Fast Recovery, 400V, 2A, MR854	10-25
CR27	Fast Recovery, 400V, 2A, MR854	10-25
CR28	Fast Recovery, 100V, 1A, 1N4934	10-31
CR29	Fast Recover, 100V, 1A, 1N4934	10-31

INDUCTOR ASSEMBLIES

REF. DES.	DESCRIPTION	WILTRON PART NO.
L1	SPEC-A-8076	310-66
L2	SPEC-A-8077	310-67
L3	SPEC-A-8074	310-64
L4	SPEC-A-8075	310-65
L5	SPEC-A-8076	310-66
L6	SPEC-A-8074	310-64

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	PNP, 2N2907	20-2N2907
Q2	NPN, 2N2222A	20-2N2222A
Q3	PNP, MPSA92	20-MPSA92
Q4	PNP, MPSA92	20-MPSA92
Q5	HEXFET, 1Ω, 350V, 3.5A, 1RF730	20-39
Q6	HEXFET, 1Ω, 350V, 3.5A, 1RF730	20-39

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 147Ω	110-147-1
R2	MF, 1/4W, 1%, 3.16k	110-3.16k-1
R3	MF, 1/4W, 1%, 22.1k	110-22.1k-1
R4	MF, 1/4W, 1%, 2.26k	110-2.26k-1
R5	MF, 1/4W, 1%, 22.1k	110-22.1k-1
R6	Trimmer, 1k	156-1k
R7	MF, 1/4W, 1%, 6.49k	110-6.49k-1
R8	CC, 1/4W, 5%, 22M	101-22M-5
R9	MF, 1/4W, 1%, 42.2k	110-42.2k-1
R10	MF, 1/4W, 1%, 4.53k	110-4.53k-1
R11	MF, 1/4W, 1%, 147Ω	110-147-1
R12	MF, 1/4W, 1%, 750k	110-750k-1
R13	MF, 1/4W, 1%, 10k	110-10k-1
R14	MF, 1/4W, 1%, 10k	110-10k-1
R15	MF, 1/4W, 1%, 3.32k	110-3.32k-1
R16	MF, 1/4W, 1%, 3.32k	110-3.32k-1
R17	MF, 1/4W, 1%, 499Ω	110-499-1
R18	MF, 1/4W, 1%, 499Ω	110-499-1
R19	MF, 1/4W, 1%, 24.9k	110-24.9k-1
R20	MF, 1/4W, 1%, 1.47k	110-1.47k-1
R21	MF, 1/4W, 1%, 10k	110-10k-1
R22	MF, 1/4W, 1%, 100k	110-100k-1
R23	MF, 1/4W, 1%, 14.7k	110-14.7k-1
R24	MF, 1/4W, 1%, 13.3k	110-13.3k-1
R25	MF, 1/4W, 1%, 6.81k	110-6.81k-1
R26	MF, 1/4W, 1%, 8.45k	110-8.45k-1
R27	Trimmer, 5k	156-5k
R28	MF, 1/4W, 1%, 1k	110-1k-1
R29	MF, 1/4W, 1%, 1k	110-1k-1
R30	MF, 1/4W, 1%, 1k	110-1k-1
R31	MF, 1/4W, 1%, 1k	110-1k-1
R32	CC, 1/2W, 5%, 100k	102-100k-5
R33	CC, 1/2W, 5%, 100k	102-100k-5
R34	CC, 1/2W, 5%, 100k	102-100k-5
R35	CC, 2W, 5%, 750Ω	104-750-5
R36	MF, 1/4W, 1%, 10Ω	110-10-1
R37	MF, 1/4W, 1%, 10Ω	110-10-1
R38	MF, 1/4W, 1%, 30.1Ω	110-30.1-1
R39	MF, 1/4W, 1%, 30.1Ω	110-30.1-1
R40	CC, 1/2W, 5%, 51Ω	102-51-5
R41	MF, 1/4W, 1%, 100Ω	110-100-1
R42	MF, 1/4W, 1%, 100Ω	110-100-1
R43	CC, 1/2W, 5%, 150Ω	102-150-5
R44	CC, 1/2W, 5%, 150Ω	102-150-5
R45	MF, 1/4W, 1%, 100Ω	110-100-1
R46	MF, 1/4W, 1%, 1k	110-1k-1
R47	CC, 2W, 5%, 750Ω	104-750-5

TRANSFORMERS

REF. DES.	DESCRIPTION	WILTRON PART NO.
T1	Driver Transformer Assy SPEC-A-8078	320-56
T2	Driver Transformer Assy SPEC-A-8078	320-56
T3	Output Transformer Assy SPEC-A-8079	320-57
T4	Common-Mode-Isolation	320-70

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Voltage Regulator, 12V, UA7812	54-LM340T-12
U2	Op Amp, LF356H	50-2
U3	Timer, 555NE	54-555
U4	Pulse Width Modulator, MC3420P	54-140

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
TP1 thru TP10	Pins, Test Point	706-44
----	Ejector, P.C. Board	553-96
----	Insulator for Q5 and Q6	790-67

Table 6-24. A14 Motherboard (660-D-8014)

CAPACITORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
C1	Disc Ceramic, 500V, 0.001μF	230-3
C2	Disc Ceramic, 500V, 0.001μF	230-3
C3	Disc Ceramic, 500V, 0.001μF	230-3
C4	Electrolytic, 35V, 470μF	250-87
C5	Disc Ceramic, 1kV, 0.01μF	230-40
C6	Disc Ceramic, 1kV, 0.01μF	230-40
C7	Disc Ceramic, 1kV, 0.01μF	230-40
C8	Disc Ceramic, 1kV, 0.01μF	230-40
C9	Disc Ceramic, 1kV, 0.01μF	230-40
C10	Disc Ceramic, 1kV, 0.01μF	230-40
C11	Disc Ceramic, 1kV, 0.01μF	230-40
C12	Electrolytic, 200V, 850μF	250-86
C13	Electrolytic, 200V, 850μF	250-86
C14	Disc Ceramic, .01μF	230-11
C15	Tantalum, 35V, 6.8μF	250-41A
C16	Tantalum, 35V, 6.8μF	250-41A
C17	Tantalum, 35V, 6.8μF	250-41A
C18	Electrolytic, 63V, 10μF	250-34
C19	Tantalum, 35V, 6.8μF	250-41A
C20	Tantalum, 35V, 6.8μF	250-41A
C21	Electrolytic, 63V, 47μF	250-51
C22	Electrolytic, 25V, 100μF	250-50
C23	Tantalum, 25V, 10μF	250-42
C24	Tantalum, 25V, 10μF	250-42
C25	Tantalum, 25V, 10μF	250-42
C26	Tantalum, 35V, 1μF	250-19
C27	Mylar, 250V, 0.1μF	210-30
C28	Mica, 560pF	223-560
C29	Mica, 560pF	223-560
C30	Mica, 560pF	223-560
C31	Mica, 560pF	223-560
C32	Disc Ceramic, .01μF	230-11
C33	Monolithic, 100V, 0.1μF	230-37
C34	Tantalum, 35V, 6.8μF	250-41A
C35	Monolithic, 100V, .1μF	230-37
C36	Electrolytic, 63V, 10μF	250-34
C37	Tantalum, 1μF, 35V	250-19

DIODES AND BRIDGE RECTIFIER

REF. DES.	DESCRIPTION	WILTRON PART NO.
CR1	Zener, 18V, 0.4W	10-1N967B
CR2	Zener, 5.6V, 0.4W	10-1N752A
CR3	Silicon, 1N4446	10-1N4446
CR4	Silicon, 1N4446	10-1N4446
CR5	Silicon Rectifier, SI2	10SI2
CR6	Silicon Rectifier, SI2	10-SI2
CR7	Silicon Rectifier, SI2	10-SI2
CR8	Silicon Rectifier, SI2	10-SI2
CR9	Silicon Rectifier, SI2	10-SI2
CR10	Silicon Rectifier, SI2	10-SI2
CR11	Silicon Rectifier, SI2	10-SI2
CR12	Bridge Rectifier	60-13
CR13	Silicon, 1N4446	10-1N4446
CR14	Zener, 4.7V, 0.4W	10-11
CR15	Silicon Rectifier, SI2	10-SI2
CR16	Silicon Rectifier, SI2	10-SI2
CR17	Silicon, 1N4446	10-1N4446
CR18	Silicon, 1N4446	10-1N4446
CR19	Silicon, 1N4446	10-1N4446
CR20	Silicon, 1N4446	10-1N4446
CR21	Silicon Rectifier, SI2	10-SI2
CR22	Silicon, 1N4446	10-1N4446
CR23	Silicon Rectifier, SI2	10-SI2
CR24	Silicon Rectifier, SI2	10-SI2
CR25	Silicon Rectifier, SI2	10-SI2
CR26	Silicon Rectifier, SI2	10-SI2
CR27	Silicon Rectifier, SI2	10-SI2
CR28	Silicon Rectifier, SI2	10-SI2
CR29	Silicon Rectifier, SI2	10-SI2
CR30	Silicon Rectifier, SI2	10-SI2
CR31	Silicon Rectifier, SI2	10-SI2
CR32	Silicon Rectifier, SI2	10-SI2
CR33	Silicon Rectifier, SI2	10-SI2
CR34	Silicon, 1N4446	10-1N4446
CR35	Silicon, 1N4446	10-1N4446
CR36	Silicon, 1N4446	10-1N4446

LED'S

REF. DES.	DESCRIPTION	WILTRON PART NO.
DS1	Light Emitting, Green	15-6
DS2	Light Emitting, Red	15-5
DS3	Light Emitting, Red	15-5
DS4	Light Emitting, Red	15-5
DS5	Light Emitting, Red	15-5

CONNECTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
P1	10-Pin, Straight	551-234
P2	4-Pin, Straight	551-88
P3	26-Pin, Straight	551-216
P4	26-Pin, Right Angle	551-217
P5	26-Pin, Right Angle	551-217
P6	26-Pin, Right Angle	551-217
P7	26-Pin, Right Angle	551-217
P8	3-Pin, Right Angle	551-238
P9	Not Used	
P10	4-Pin Right Angle	551-240
P11	Not Used	
P12	5-Pin	551-245
P13	16-Pin	551-242
P14	16-Pin	551-242
P15	10-Pin, Straight	551-234
P16	16-Pin	551-242
P17	16-Pin	551-242
P18 thru P30	3-Pin, Right Angle	551-238
P31	9-Pin	551-243
P32	Not Used	
P33	2-Pin, Right Angle	551-241
P34	2-Pin, Right Angle	551-241
P35	3-Pin, Right Angle	551-238
P36	3-Pin, Right Angle	551-238
P37	2-Pin, Right Angle	551-241
P38	2-Pin, Right Angle	551-241
P39	3-Pin, Right Angle	551-238
XA1 thru XA10 & XA13	Receptacle, PCB, 56-Pin	551-198
XA16	Socket, 16-Pin, DIP	553-48

TRANSISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
Q1	NPN, MPSA42	20-MPSA42
Q2	PNP, MPSA92	20-MPSA92
Q3	PNP, MPSA92	20-MPSA92
Q4	NPN, 2N3694	20-2N3694
Q5	PNP, 2N4249	20-2N4249
Q6	PNP, 2N4249	20-2N4249
Q7	PNP, 2N4249	20-2N4249
Q8	NPN, 2N3694	20-2N3694
Q9	PNP, 2N4249	20-2N4249
Q10	NPN, 2N3694	20-2N3694
Q11	PNP, 2N4249	20-2N4249
Q12	NPN, 2N3694	20-2N3694
Q13	PNP, 2N4249	20-2N4249
Q14	PNP, 2N4249	20-2N4249
Q15	NPN, 2N3694	20-2N3694
Q16	PNP, 2N4249	20-2N4249
Q17	PNP, 2N4249	20-2N4249
Q18	NPN, 2N3694	20-2N3694
Q19	PNP, 2N4249	20-2N4249
Q20	PNP, 2N4249	20-2N4249
Q21	PNP, 2N4249	20-2N4249
Q22	NPN, 2N3694	20-2N3694

RESISTORS

REF. DES.	DESCRIPTION	WILTRON PART NO.
R1	MF, 1/4W, 1%, 16.9 kΩ	110-16.9k-1
R2	MF, 1/4W, 1%, 3.32 kΩ	110-3.32k-1
R3	MF, 1/4W, 1%, 196Ω	110-196-1
R4	MF, 1/4W, 1%, 1.78 kΩ	110-1.78k-1
R5	MF, 1/4W, 1%, 1.27 kΩ	110-1.27k-1
R6	MF, 1/4W, 1%, 5.9 kΩ	110-5.9k-1
R7	Variable, Single-Turn, 2 kΩ	156-2k-A
R8	WW, 3W, 1Ω	130-1-3
R9	MF, 1/4W, 1%, 100Ω	110-100-1
R10	CC, 1/2W, 5%, 5.6 kΩ	102-5.6k-5
R11	MF, 1/4W, 1%, 12.7 kΩ	110-12.7k-1
R12	MF, 1/4W, 1%, 2.21 kΩ	110-2.21k-1
R13	MF, 1/4W, 1%, 10Ω	110-10-1
R14	CC, 1/2W, 5%, 100 kΩ	102-100k-5
R15	CC, 1/2W, 5%, 100 kΩ	102-100k-5
R16	WW, 3W, 1Ω	130-1-3
R17	MF, 1/4W, 1%, 100Ω	110-100-1
R18	MF, 1/4W, 1%, 365Ω	110-365-1
R19	MF, 1/4W, 1%, 3.32 kΩ	110-3.32k-1
R20	MF, 1/4W, 1%, 19.1Ω	110-19.1-1
R21	MF, 1/4W, 1%, 42.2Ω	110-42.2
R22	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R23	MF, 1/4W, 1%, 88.7 kΩ	110-88.7k-1
R24	MF, 1/4W, 1%, 88.7 kΩ	110-88.7k-1
R25	MF, 1/4W, 1%, 215 kΩ	110-215k-1
R26	MF, 1/4W, 1%, 61.9 kΩ	110-61.9k-1
R27	MF, 1/4W, 1%, 107 kΩ	110-107k-1
R28	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R29	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R30	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R31	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R32	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R33	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R34	WW, 3W, 120Ω	130-120-3
R35	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R36	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R37	CC, 2W, 5%, 220Ω	104-220-5
R38	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R39	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R40	MF, 1/4W, 1%, 69.8Ω	110-69.8-1
R41	MF, 1/4W, 1%, 100Ω	110-100-1
R42	MF, 1/4W, 1%, 69.8Ω	110-69.8-1
R43	MF, 1/4W, 1%, 69.8Ω	110-69.8-1
R44	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R45	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R46	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R47	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R48	MF, 1/4W, 1%, 68.1Ω	110-68.1-1
R49	Not Used	
R50	CC, 2W, 5%, 220Ω	104-220-5
R51	Not Used	
R52	Not Used	
R53	Not Used	
R54	Not Used	
R55	Not Used	

R56	Not Used	
R57	Not Used	
R58	Not Used	
R59	Not Used	
R60	Not Used	
R61	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R62	Not Used	
R63	Not Used	
R64	Not Used	
R65	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R66	Not Used	
R68	CC, 2W, 5%, 220Ω	104-220-5
R69	MF, 1/4W, 1%, 11.8 kΩ	110-11.8k-1
R70	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R71	MF, 1/4W, 1%, 100Ω	110-100-1
R72	MF, 1/4W, 1%, 10.5 kΩ	110-10.5k-1
R73	MF, 1/4W, 1%, 12.7 kΩ	110-12.7k-1
R74	MF, 1/4W, 1%, 1.33 kΩ	110-1.33k-1
R75	MF, 1/4W, 1%, 15.4 kΩ	110-15.4k-1
R76	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R77	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R78	MF, 1/4W, 1%, 287Ω	110-287-1
R79	Variable, Single-Turn, 5 kΩ	156-5k-A
R80	Variable, Single-Turn, 5 kΩ	156-5k-A
R81	MF, 1/4W, 1%, 200 kΩ	110-200k-1
R82	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R83	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R84	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R85	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R86	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R87	MF, 1/4W, 1%, 22.1 kΩ	110-22.1k-1
R88	MF, 1/4W, 1%, 12.1 kΩ	110-12.1k-1
R89	Variable, Multi-Turn, 100 kΩ	157-100kA
R90	MF, 1/4W, 1%, 287Ω	110-287-1
R91	MF, 1/4W, 1%, 287Ω	110-287-1
R92	MF, 1/4W, 1%, 287Ω	110-287-1
R93	MF, 1/4W, 1%, 22.1 kΩ	110-22.1k-1
R94	MF, 1/4W, 1%, 22.1 kΩ	110-22.1k-1
R95	MF, 1/4W, 1%, 22.1 kΩ	110-22.1k-1
R96	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R97	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R98	MF, 1/4W, 1%, 10 kΩ	110-10k-1
R99	CC, 1/2W, 5%, 0.5Ω	102-.5-5
R100	CC, 1/2W, 5%, 0.5Ω	102-.5-5
R101	CC, 1/2W, 5%, 0.5Ω	102-.5-5
R102	MF, 1/4W, 1%, 4.99 kΩ	110-4.99k-1
R103	MF, 1/4W, 1%, 2 kΩ	110-2k-1
R104	MF, 1/4W, 1%, 6.81 kΩ	110-6.81k-1
R105	MF. 1/4W, 1%, 68.1 kΩ	110-68.1-1
R106	MF, 1/4W, 1%, 100Ω	110-100-1
R107	MF, 1/4W, 1%, 31.6Ω	110-31.6-1
R108	MF, 1/4W, 1%, 68.1Ω	110-68.1-1
RP1	Resistor Network	123-6
RP2	Resistor Network	123-6
RP3	Resistor Network	123-6
RP4	Resistor Network	123-6

INTEGRATED CIRCUITS

REF. DES.	DESCRIPTION	WILTRON PART NO.
U1	Optical Isolator, 820	20-820
U2	Voltage Regulator, 24V	54-152
U3	Not Used	
U4	Op Amp, LM10	50-16
U5	Quad Comparator, MC3302P	54-MC3302P
U6	Octal Latch, 74LS374	54-41
U7	Octal Latch, 74LS373	54-103
U8	Octal Latch, 74LS373	54-103
U9	Dual D Flip-Flop 74LS74	54-44
U10	Octal Latch, 74LS373	54-103

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
---	Clip, Fuse	553-37
F1	Fuse, 5A, FB, 3AG	631-25
K1	Relay, 5V, SPDT	690-19
L1	Inductor Assembly, SPEC-A-8080	310-68
L2	Inductor Assembly, SPEC-A-8080	310-68
RT1	Thermistor	35-7
RT2	Thermistor	35-7
RV1	Varistor	35-6
RV2	Varistor	35-6
TP1 thru TP6	Test Points	706-44
XA16	Socket, 16-Pin, DIP	553-48

Table 6-25. A18 GPIB Connector (660-B-8018)

MISCELLANEOUS

REF. DES.	DESCRIPTION	WILTRON PART NO.
J2	Socket, 14-Pin, Right Angle	551-149
P1	Connector, GPIB Interface	553-72
P2	Connector, Mounting Hardware	553-72A
R1	Resistor, 1/4W, 1%, 10Ω	110-10-1
S1	Switch, SPST, 6 Section	430-105
---	Cable Assy. (A18 to A14P4)	804-26E1-16 1/4

Table 6-26. Options and Accessories Parts List

Option 1, Rack Mount

NAME	PART NO.
Left Side Assembly	660-D-8111
Right Side Assembly	660-D-8112

Option 2, Step Attenuator

Step Attenuator	1010-27
Cable Assembly, Coupler to Step Attenuator	660-A-8121-1
Cable Assembly, Attenuator to Rear Panel	660-A-8143-1
Connector Housing, 9-pin	551-200

Option 3, GPIB Interface

A1 GPIB Interface PCB (see Table 6-1)	660-D-8001-3
A18 GPIB Connector PCB (see Table 6-25; attached to rear panel)	660-B-8018

Option 11, External Square-Wave Input, Standard (except 6642A)

PIN Switch Modulator	1020-17

Option 13, Counted Markers

BNC Connector, Rear-Panel	510-42

Accessories

PCB Extender Board	660-D-8062-3

Table 7-1. Service Section Organization

TITLE OF INFORMATION	PAGE	PARAGRAPH
Removal and Installation Procedures	7-1	7-3
Overall Circuit Description	7-8	7-4
Overall Troubleshooting, Description	7-17	7-5
Overall Troubleshooting Flowchart	7-16	
A12 Microprocessor PCB, Description	7-17	7-6
A12 PCB Schematic	7-22	
A12 PCB Troubleshooting Flowchart	7-28	
A11 Front Panel PCB, Description	7-35	7-7
A11 PCB Schematic	7-39	
A1 GPIB Interface PCB, Description	7-41	7-8
A1 PCB Schematic	7-45	
A1 PCB Troubleshooting Flowchart	7-48	
A2 Ramp Generator PCB, Description	7-55	7-9
A2 PCB Schematic	7-60	
A2 PCB Troubleshooting Flowchart	7-65	
A3 Marker Generator PCB, Description	7-67	7-10
A3 PCB Schematic	7-73	
A3 Troubleshooting Flowchart	7-79	
A4 Automatic Level Control PCB, Description	7-83	7-11
A4 PCB Schematic	7-86	
A4 PCB Troubleshooting Flowchart	7-93	
A5 Frequency Instruction and A6-A9 YIG Driver PCBs, Description	7-106	7-12
A5 PCB Schematic	7-106	
A6 PCB Description, Assy. 660-D-8007-3, -5, -7, & -99-91	7-115	
A6 PCB Description, Assy. 660-D-8007-4	7-128	
A6 PCB Description, Assy. 660-D-8007-6	7-134	
A6 PCBs Description, Assy. 660-D-8190 and - 8191	7-140	
A7-A9 PCBs Description, Assy. 660-D-8008 and -8009, All Dash Numbers	7-148	
A5-A9 PCB Troubleshooting Flowcharts	7-171	
A10 FM/Attenuator PCB, Description	7-175	7-13
A10 PCB Schematic	7-178	
A10 PCB Troubleshooting Flowchart	7-181	
RF Deck, Description	7-183	7-14
Model 6609A RF Deck Block Diagram	7-184	
Model 6617A RF Deck Block Diagram	7-184	
Model 6621A/6621A-40 RF Deck Block Diagram	7-185	
Model 6629A/6629A-40 RF Deck Block Diagram	7-185	
Model 6627A/6637A-40/6638A RF Deck Block Diagram	7-185	
Model 6642A RF Deck Block Diagram	7-187	
Model 6647A/6648A RF Deck Block Diagram	7-186	
Model 6653A RF Deck Block Diagram	7-188	
Model 6659A RF Deck Block Diagram	7-189	
A13/A14 PCBs Switching Power Supply, Description	7-190	7-15
A13/A14 PCB Schematic	7-195	
A14 Motherboard PCB Wire Lists	7-202	
A13/A14 PCBs Troubleshooting Flowcharts	7-229	
A13 PCB Low-Voltage Troubleshooting Procedure	7-233	
A18 GPIB Connector PCB, Description	7-230	7-16
A18 PCB Schematic	7-237	

SECTION VII

SERVICE

7-1 INTRODUCTION

This section contains general information, disassembly/reassembly instructions, and service information – circuit descriptions, schematics, parts locator diagrams, and troubleshooting data – for the overall sweep generator and individual printed circuit boards (PCBs). This service information is organized as shown in Table 7-1 (facing page).

7-2 GENERAL INFORMATION

7-2.1 Printed Circuit Board (PCB) Exchange Program

WILTRON has an exchange program that includes most of the 6600A Series PCBs. Upon request, WILTRON will immediately ship a replacement for any sweep generator PCB covered by this program. The customer has 30 days in which to return the defective PCB. Contact Customer Service at 415-969-6500 to make arrangements for an exchange.

7-2.2 Recommended Test Equipment for Troubleshooting

A list of the recommended test equipment for troubleshooting the sweep generator is provided in Table 7-2.

7-3 6600A SERIES PROGRAMMABLE SWEEP GENERATOR, REMOVAL AND REINSTALLATION INSTRUCTIONS

Instructions for the removal and reinstallation or the disassembly and reassembly of certain 6600A Series Sweep Generator components and subassemblies are provided in paragraphs 7-3.1 thru 7-3.5.

7-3.1 Front Panel Assembly, Removal and Reinstallation Instructions

a. Removal.

1. Turn off ac power.
2. Remove the top, bottom, and side covers of the basic frame as follows:
   (a) Remove the four corner brackets from the rear panel (Figure 7-1).
   (b) Slide the covers to the rear and remove.
3. Stand the sweep generator on its side, with the RF Deck up.
4. Disconnect the cable connector from A14P37 (Figure 7-2).
5. Using a 3/32-inch hex wrench, remove the four corner and two mid-panel screws securing the front panel assembly to the basic frame (Figure 7-3).
6. Reposition the sweep generator top-side up (sitting on its feet); gently push the front panel assembly away from the front of the basic-frame assembly.
7. Disconnect the ribbon connectors from P5, P6, and P7 on the A12 Microprocessor PCB. Use care to avoid bending the connector pins.

b. Reinstallation. The reinstallation procedure for the front panel assembly is a reversal of the removal procedure.

CAUTION

To prevent chafing, insure that the 3-wire harness going

Table 7-2. Recommended Test Equipment for Troubleshooting

INSTRUMENT	REQUIRED CHARACTERISITCS	RECOMMENDED MANUFACTURER
Digital Multimeter	Dc Voltage: .05% to 30V .002% to 10V.	John Fluke Co. Model 8600A
Oscilloscope	60 MHz bandwidth, 1mV vertical sensitivity, and variable external horizontal input capability.	Tektronix Models 5440/5A18/5B10
Scalar Network Analyzer	Ability to display frequency response of sweep generator.	WILTRON Model 560A
RF Detector	Ability to detect signals within the 10 MHz to 26.5 GHz frequency range.	WILTRON Model 7S50, Option 2
Signature Analyzer	Ability to make signature analysis of microprocessor circuitry.	Hewlett-Packard Model 5004A
Directional Coupler	Ability to couple signals within a portion of the 10 MHz to 18 GHz frequency range.	NARDA Model 3202B-10
DC Power Supply	3 volts @ 3 amps	HP 6281
Dual DC Power Supply	1 supply = 0 to 7V 1 supply = +15V Common ground OK.	HP 6236B
DC Power Supply	30V - Isolated from ground and other voltage supplies.	HP 6216

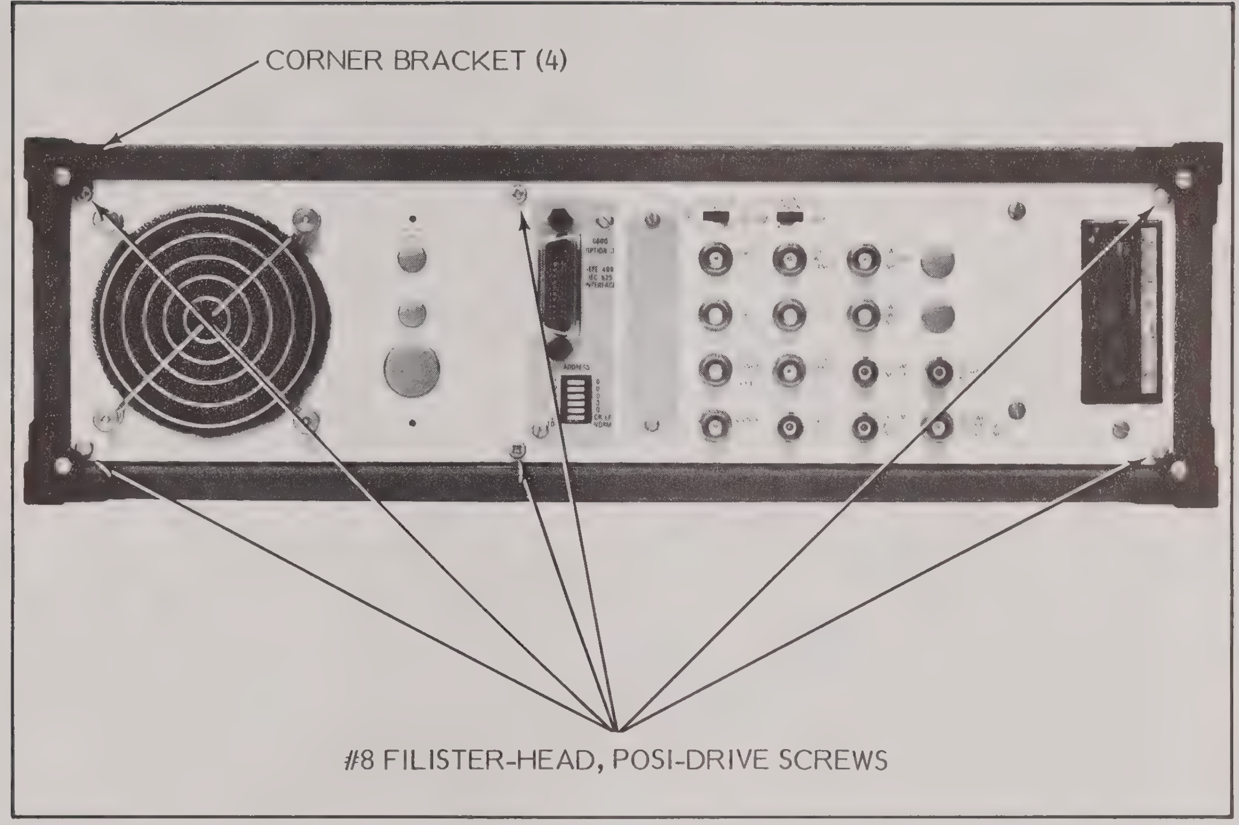


Figure 7-1. 6600A Series Programmable Sweep Generator, Rear Panel

to A12P8 is well clear of the bottom mid-panel screw that secures the front panel assembly to the basic frame.

7-3.2 Front Panel, Disassembly and Reassembly Instructions

a. Disassembly.

1. Remove the front panel assembly from the basic frame; refer to paragraph 7-3.1.

CAUTION

The INCREASE/DECREASE lever extends out approximately 1/4 inch beyond the surfaces of the front panel pushbuttons. Use care to prevent bending the lever shaft.

2. Disconnect the 5-wire connector from A12P4.

3. Disconnect the 3-wire connector from A12P8.

CAUTION

The A12 and A11 PCBs are interconnected using 4 in-line-pin connectors (Figure 7-4). When separating the two PCBs, use care to avoid bending connector pins.

4. Remove the six 1/2-inch 4-40 screws, flatwashers, and lockwashers from the A12 PCB; separate the A12 PCB from the A11 PCB.

5. Remove the knobs from the MANUAL SWEEP, MARKER AMPLITUDE, and EXTERNAL ALC GAIN

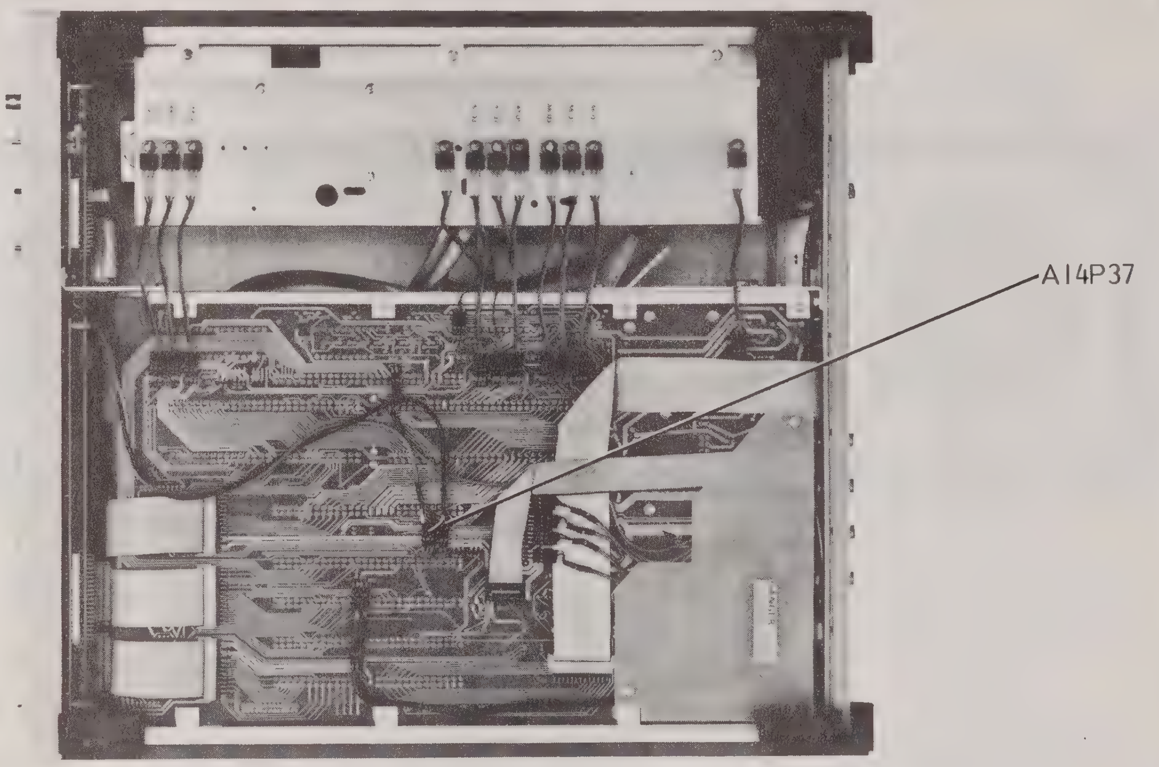


Figure 7-2. 6600A Series Programmable Sweep Generator, Bottom View

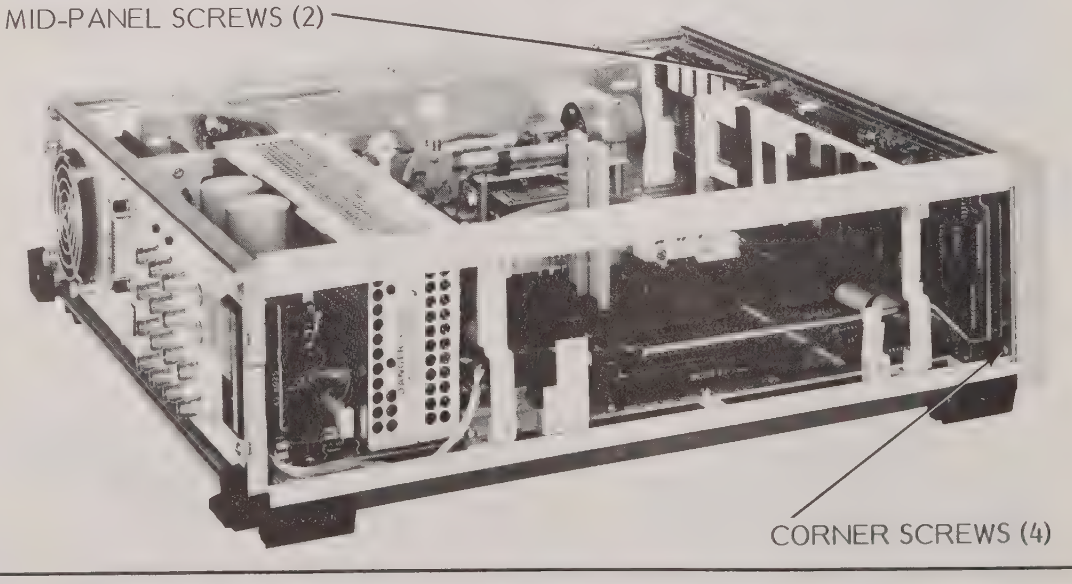

MID-PANEL SCREWS (2)
CORNER SCREWS (4)

Figure 7-3. 6600A Series Programmable Sweep Generator, Side View

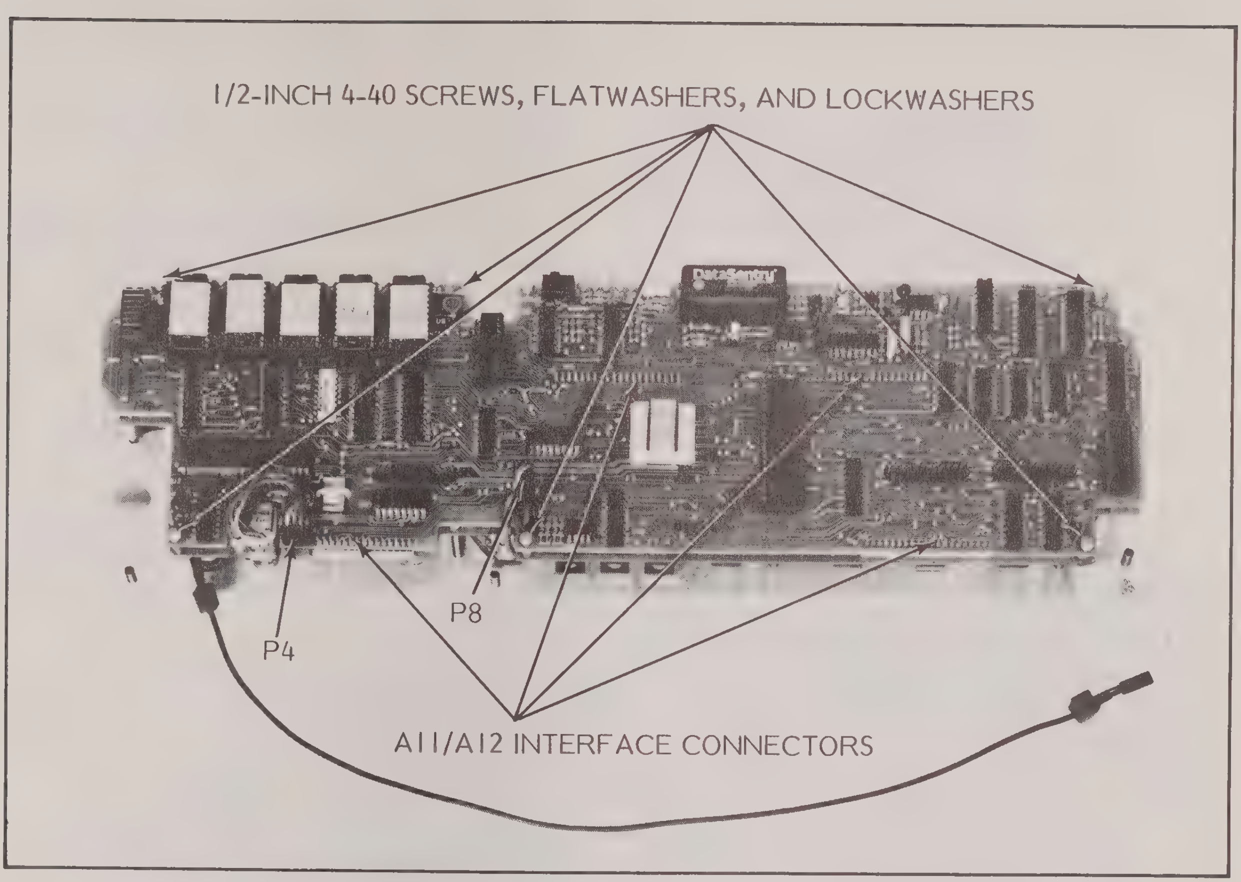

1/2-INCH 4-40 SCREWS, FLATWASHERS, AND LOCKWASHERS
P8
P4
A11/A12 INTERFACE CONNECTORS

Figure 7-4. 6600A Series Programmable Sweep Generator, Front Panel Assembly

controls. To remove, pull knobs straight off.

6. Remove the eight 7/8-inch 4-40 screws, flatwashers, and lockwashers from the A11 PCB.

7. Separate the A11 PCB from the front panel.

b. Reassembly.

1. Mount the A11 PCB onto the front panel. Use care to insure that the LEDs and pushbuttons are properly aligned with their respective cutouts on the front panel.

2. Reinstall the eight 7/8-inch 4-40 screws, flatwashers, and lockwashers so that they are snug, but not tight, to the PCB.

3. Check each pushbutton, especially those on the keypad, and insure that none is binding. Reposition the A11 PCB slightly, if required, to prevent pushbutton binding.

4. Tighten the eight A11 retaining screws.

5. Reinstall the knobs on the MANUAL SWEEP, MARKER AMPLITUDE, and EXTERNAL ALC GAIN controls.

NOTE

The knob with the "shoulder" goes on the EXTERNAL ALC GAIN potentiometer.

6. Rejoin the A11 and A12 PCBs, as follows:

   (a) Position the A12 PCB so that the male pins on P3 and P4 mate with their respective female pins on A11J3 and A11J4. Insure that the pins of A12P1 and A12P2 are aligned with their mating pins on A11J1 and A11J2.

   (b) While observing the four connectors, gently press the two PCBs together until the connectors are properly seated.

   (c) Reinstall the six 1/2-inch 4-40 screws, flatwashers, and lockwashers.

7. Reconnect the 5-wire connector to A12P4 (green wire to pin 20); see Figure 7-4.

8. Reconnect the 3-wire connector to A12P8 (brown wire to pin 1); see Figure 7-4.

9. Reinstall the front panel assembly into the basic frame; refer to paragraph 7-3.1.

7-3.3 INCREASE/DECREASE Lever, Switch-Assembly Replacement

The INCREASE/DECREASE lever switch-assembly is not repairable in the field. In the event of an electrical or mechanical failure, the entire switch-assembly must be replaced. To replace this assembly, proceed as follows:

NOTE

The knob on the INCREASE/DECREASE lever is secured to the lever shaft with an epoxy compound. The removal of this knob may cause its destruction. Consequently, when ordering a replacement INCREASE/DECREASE lever switch-assembly, a replacement knob (WILTRON part number 430-106) should be ordered also.

a. Remove the front panel assembly from the basic frame; refer to paragraph 7-3.1.

b. Disassemble the front panel assembly; refer to paragraph 7-3.2.

c. Remove the knob from the INCREASE/DECREASE lever (see NOTE above).

d. Remove the two 1/4-inch 4-40 screws, flatwashers, and lockwashers, and remove the assembly from the front panel.

e. Install the new assembly and secure using the 4-40 hardware.

f. Install new knob on lever shaft, and secure it in place using a quick-drying cement (such as a 3-minute epoxy compound).

g. Reassemble the front panel assembly; refer to paragraph 7-3.2.

h. Reinstall the front panel assembly into basic frame; refer to paragraph 7-3.1.

7-3.4 Rear Panel Assembly, Removal and Reinstallation Instructions

a. Removal.

   1. Turn off ac power and disconnect the input line voltage.

   2. Remove the top and side covers from the sweep generator as follows:

      (a) Remove the 4 corner-brackets from the rear panel of the sweep generator, Figure 7-1.

      (b) Slide the top and side covers to the rear and remove.

WARNING

There are dangerous charged-capacitor voltages present on P1 pins 3 thru 10 when power is removed. Discharge these pins to chassis ground before performing maintenance.

3. Disconnect the Molex connector from A14P1 (Figure 7-5).

4. Remove the six #8 fillister-head, posi-drive screws from the rear panel (Figure 7-1).

5. Gently push the rear panel out from the basic frame and lay it back on the work surface. It is not necessary to remove the rear panel assembly completely; all rear panel components are accessible with the panel in this position.

b. Reinstallation. The reinstallation procedure for the rear panel assembly is a reversal of the removal procedure.

7-3.5 A13 Switching Power Supply PCB, Removal and Reinstallation

WARNING

Voltages hazardous to life are present through the A13/A14 Switching Power Supply, even when power is turned off and the ac line cord is removed. Before performing maintenance on this power supply, observe the following precautions:

After ac power is turned off and the line cord is removed,

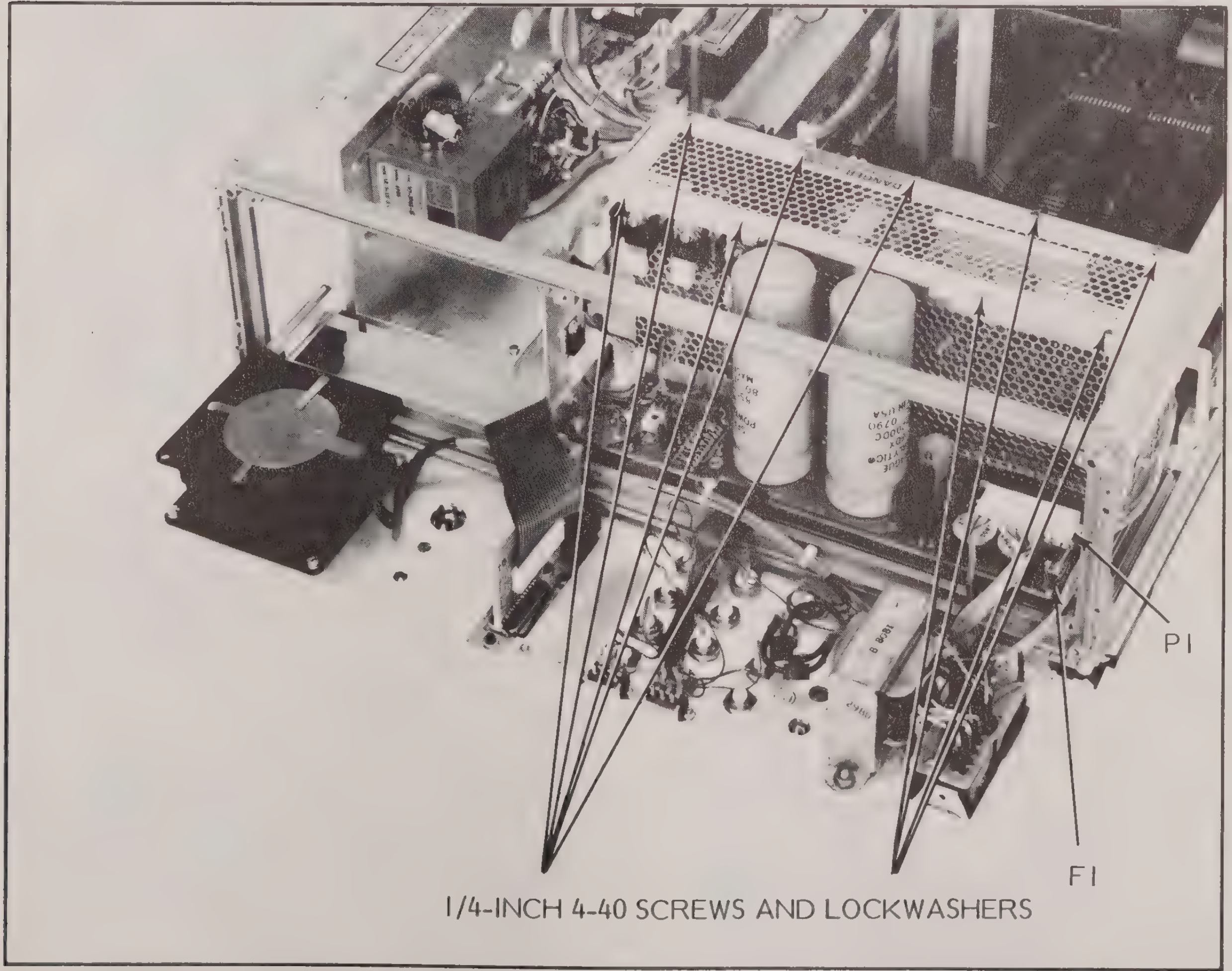


Figure 7-5. 6600A Series Programmable Sweep Generator, Rear Quarter Panels and Assemblies

allow 5 minutes for the capacitor voltages to decay.

Avoid touching the terminals on the 5A FB fuse, A14F1, (Figure 7-5) when power is turned on. +165 Vdc is present on these terminals.

a. Removal.

1. Turn off the ac power and disconnect the ac line cord from the Voltage Selector Module.
2. Remove the top cover from the sweep generator, as follows:
    (a) Remove the two top, corner brackets from the rear panel of the sweep generator (Figure 7-1).
    (b) Slide the cover to the rear and remove.
3. Remove the ten 1/4-inch 4-40 screws and lockwashers from the top cover of the A13 card-cage assembly, and remove the cover.
4. Using the ejectors on the ends of the PCB, eject the PCB from the XA13 socket.

b. Reinstallation. The reinstallation instructions are a reversal of the removal instructions.

NOTE

The A13 PCB power supply switching-frequency is in the RF spectrum (50 kHz). To prevent this RF energy from being radiated, insure that the card-cage cover is securely seated and fastened with all ten screws before the ac power is reapplied.

7-4 6600A SERIES PROGRAMMABLE SWEEP GENERATOR, OVERALL CIRCUIT DESCRIPTION

The 6600A Series Programmable Sweep Generator is a microprocessor-controlled, broadband sweeper that uses drop-in (rather than plug-in) radio- and microwave-frequency components. Like most other sweepers, the 6600A is organized into "mainframe" circuits that are universal for all models and frequency components that are model-dependent. For descriptive purposes, the model-dependent circuits are subdivided into five classes: Models 6609A/6617A, Models 6621A/ 6621A-40/ 6629A/ 6629A-40, Models 6637A/ 6637A-40/ 6638A/ 6647A/ 6648A, Models 6653A/6659A, and Model 6642A. Overall block diagrams for the 6609A/6617A, 6637A/6637A-40/6638A/6647A/6648A, and 6653A/6659A are provided in Figures 7-7 thru 7-9 respectively.

a. Universal Circuits. The 6600A series universal circuits consist of the following printed circuit boards (PCBs): A12 Microprocessor, A11 Front Panel, A1 GPIB Interface (Option 3), A2 Ramp Generator, A3 Marker Generator, A4 Automatic Level Control (ALC), A5 Frequency Instruction, and A10 FM/Attenuator.

The A12 Microprocessor PCB provides overall control for RF signal generation. As shown in Figure 7-7, the A12 PCB interfaces with the Analog Circuits via the **μP Bus**, and with the front panel controls via the A11 PCB. The A12 PCB is described in paragraph 7-6.1.

The A11 Front Panel PCB provides an interface for all of the front panel pushbuttons except RESET and SELF TEST. These two pushbuttons are connected directly to the A12, where their activation causes microprocessor interrupt routines to be generated. The A11 PCB is described in paragraph 7-7.1.

The A1 GPIB Interface PCB is only installed for sweep generators containing Option 3. This PCB provides interface between the IEEE-488 Interface Bus (General Purpose Interface Bus--GPIB) and the sweep generator. The A1 PCB is described in paragraph 7-8.1.

The A2 Ramp Generator PCB is the sweep-generation source when either the

TRIGGER-AUTO, -LINE, or -EXT OR SINGLE pushbutton is used to select the triggering mode. These three pushbuttons control the A2 sweep ramp via the **μP BUS**. Triggering for the A2 sweep ramp is accomplished via the **μP Bus** for the single sweep mode, via the **EXT TRIGGER IN** line for the external sweep mode, or via the **AC LINE VOLTAGE** input for the line trigger mode. The remaining two input lines, **INTENSITY MARKER** and **EOB**, cause the A2 sweep ramp to dwell momentarily. The **INTENSITY MARKER** line causes the ramp to dwell when an intensity marker is commanded. And the **EOB** line causes the ramp to dwell during an oscillator bandswitch (see NOTE). The A2 PCB output lines include the **RAMP OUT** signal that goes to the A5 PCB and the five signals that go to the rear panel connectors: **BANDSWITCH BLANKING (+), (-); RETRACE BLANKING (+), (-);** and **SEQ SYNC**. The A2 PCB is described in paragraph 7-9.1.

NOTE

> As shown in Figure 7-8, three YIG oscillators are used to generate a full-band sweep with the Models 6637A/38A/47A/48A. The frequency at which the sweep (or CW tuning) goes from a lower- to a higher-frequency oscillator (or from the heterodyne band to the first oscillator band) is known as the bandswitch point.

The A3 Marker Generator PCB generates the F0, M1, and M2 markers. The marker frequency and mode (VIDEO, RF, INTENSITY) data enters A3 via the **μP BUS**. The frequency data is converted to an analog voltage, compared with the **RAMP, 0-10V**, signal, and used to generate the frequency marker. The mode data selects the type of marker to be displayed: either intensity, RF, or video. The **RAMP, 0-10V**, signal is also buffered on A3 and supplied to the rear panel HORIZ OUTPUT connector. The A3 PCB, in addition to generating markers, also contains the logic circuitry associated with the front panel INCREASE/DECREASE lever. The **MODIFY SIGNAL** line provides the input to this logic circuitry. The frequency data generated by this logic circuitry is in the form of an 8-bit digital word. This word is sent to the microprocessor via the **μP Bus**. The A3 PCB is described in paragraph 7-10.1.

The A4 Automatic Level Control PCB is the control arm for the RF-output-signal leveling loop. The input arm for the leveling loop is either the built-in Coupler/Detector that is used for internal leveling, or it is the external coupler and detector (or power meter) that is required for external leveling. The output arm of the leveling loop is the PIN switch attenuator current-driver circuit (not shown) located on the A6-A9 YIG Driver PCBs. These current-driver circuits operate the **MOD DRIVER 1, 2, 3,** and **4** lines used to control Mod and PIN switch attenuation. The A4 also performs the following functions:

1. It sets the magnitude of the RF output power, which the user selects using the front panel LEVEL pushbutton.
2. It creates a "dip" in output power at the RF marker frequency.
3. It provides the RF SLOPE correction to the output power signal.

The A4 PCB, in addition to controlling the leveling loop, provides a latch for the **ATTN 1** through **ATTN 4** control bits. These control bits come from the microprocessor and go to the A10 PCB. The A4 PCB is described in paragraph 7-11.1.

The A5 Frequency Instruction PCB generates tuning and bandswitch-control voltages for the A6-A9 YIG Driver PCBs. The bandswitch-control voltage is the **FCEN/VPF** signal, and the tuning voltages are the **F CEN**, **ΔF>50 MHz**, and **F CORR** signals. There are three sweep-voltage-producing sources in the sweep generator: The A2 PCB, the front panel MANUAL SWEEP potentiometer, and the Step Frequency DAC (digital-to-analog converter, paragraph 3-7.2), located on A5. One of these sources, as determined by the microprocessor, is selected on A5 and used to generate the **ΔF >50 MHz** signal. The center frequency, which the user selects using the front panel FREQUENCY RANGE controls, provides the **F CEN** signal. And a correction voltage, which is the sum of the FREQUENCY VERNIER signal from the front panel and the Linearizing ROM signal (see NOTE) from the applicable A6-A9 YIG Driver PCB, provides the **F CORR** signal. The FREQUENCY VERNIER signal enters A5 via the **µP Bus**, and the linearizing ROM signal enters via the **FC** (frequency correction) **Bus**. The A5 PCB also supplies a tuning signal, **ΔF≤50 MHz**, for the FM coil in the YIG oscillator; this signal goes to the A10 PCB. The **ΔF≤50 MHz** signal sweeps the YIG oscillator via the FM coil when the sweep width is ≤50 MHz. The A5 PCB is described in paragraph 7-12.1.

NOTE

> Many YIG oscillators, though inherently linear, often have linearity errors due to magnetic saturation effects. To correct for linearity errors, digital data providing up to ±64 MHz of frequency correction may be stored in read-only memory (ROM). If required by the installed YIG oscillator, a Linearizing ROM is mounted on the applicable A6, A7, A8, or A9 YIG Driver PCB.

The A10 FM/Attenuator PCB provides a tuning current for the YIG Osc 1-4 FM (frequency modulation) coils and the Osc 1 YIG tracking filter. The tracking filter tuning current is derived from the **TRACK FILTER 1** voltage generated on the A6 PCB. The FM coil tuning current may be derived from either of two sources: an external FM signal from the rear panel via the EXT FM ØLOCK INPUT connector or a sweep width voltage from the A5 PCB via the **ΔF≤50 MHz** signal line. In addition to the FM and tracking filter currents, the A10 generates an end-of-band pulse (**EOB**) whenever a bandswitch occurs. The **HET YIG SEL** and YIG **1**, **2**, **3** and **4** **SEL** lines from the A6-A8 PCBs provide the input for the **EOB** circuit. The A10 PCB is described in paragraph 7-13.1.

The A14 Motherboard PCB provides an interconnecting plane for the A1 through A10 PCBs. It also provides interconnection via connectors between the A1-A10 PCBs and the A12 PCB, the rear panel connectors, and the RF Deck components. The A14 PCB also contains diagnostic (self-test) and PIN Switch port drive and attenuator circuitry; it also contains part of the switching power supply circuitry. The A14 PCB is described in paragraph 7-15.2.

The A13 Switching Power Supply PCB, in conjunction with the power supply circuits on the A14 PCB, provides power supply voltages for the sweep generator circuits. The A13/A14 Switching Power Supply is described in paragraph 7-15.1.

The A18 GPIB Interface Connector PCB provides a connecting plane for the Option 3 rear panel GPIB connector and address switches. This PCB is installed only on sweep generators containing Option 3. The A18 PCB is described in paragraph 7-16.

b. Models 6609A/6617A. The model-dependent circuits and components for the 6609A and 6617A consist of the A6 Het/YIG Driver PCB and the components shown on the RF Deck.

The A6 Het/YIG Driver PCB provides tuning and bias currents for the YIG tuning coil. The tuning current is derived from the three tuning voltages (**F CEN**, **ΔF >50 MHz**, **F CORR**) supplied by the A5 PCB. The oscillator bias current is generated on the A6 PCB. In addition to tuning and bias currents, the A6 PCB also generates a tracking filter voltage, which is supplied to the A10 PCB. This voltage indirectly provides tuning for the YIG tracking filter that is built into the 6617A

YIG module. The other A6 output is the **HET YIG SEL** line that is supplied to the A10 PCB (6617A). The A6 PCB is described in paragraph 7-12.3.

The RF Deck is a subassembly; it contains all of the sweep generator RF components. This subassembly is described in paragraph 7-14.

c. Models 6621A/6621A-40/6629A/6629A-40. The model-dependent circuits and components for these four models are as follows (Figure 7-8):

1. The 6621A and 6621A-40 consist of the A6 Het/YIG Driver PCB, A7 YIG Driver PCB, YIG OSC 1, YIG OSC 2, PIN Switch, and Coupler/Detector.
2. The 6629A and 6629A-40 consist of the A7 and A8 YIG Driver PCBs, YIG OSC 2, YIG OSC 3, PIN Switch, and Coupler Detector.

The circuit description for the model-dependent circuits is the same as that for the 6637A/6638A/6647A/6648A circuits in subparagraph d. below.

d. Models 6637A/6637A-40/6638A/6647A/6648A. The model-dependent circuits and components for these five models consist of the A6, A7, and A8 YIG Driver PCBs, and the components shown on the RF Deck (Figure 7-8).

The A6 Het/YIG Driver and the A7 and A8 YIG Driver PCBs provide tuning and bias currents for the Osc 1, 2, and 3 YIG tuning coils. The tuning currents are derived from the three tuning voltages (**F CEN, ΔF >50 MHz, F CORR**) supplied by the A5 PCB. The oscillator bias currents are generated individually on each A6-A8 PCB. In addition to tuning and bias currents, the A6 PCB also generates a tracking filter voltage, which is supplied to the A10 PCB. This voltage indirectly provides tuning for the YIG tracking filter that is built into the Osc 1 YIG module. With the exception of the MOD DRIVER signals previously described, the other A6-A8 outputs are control lines. The **SNB** and SNR lines are select-next-band and select-next-ROM lines, respectively. When the presently selected oscillator band has reached its upper-most frequency, the **SNB** line selects the next oscillator band and the **SNR** line enables this next oscillator band's linearizing ROM. The **HET YIG SEL** and **YIG 1, 2,** and **3 SEL** lines are supplied to the A10 PCB. A detailed overall description of the A6-A8 PCBs is given in paragraph 7-12.2. The A6 PCB is described in paragraph 7-12.3, and the A7 and A8 PCBs are described in paragraph 7-12.4.

The RF Deck is a subassembly; it contains all of the sweep generator RF components. This subassembly is described in paragraph 7-14.

e. Models 6653A/6659A. The model-dependent circuits and components for the 6653A and 6659A consist of the A6-A9 YIG Driver PCBs and the components shown on the RF Deck (Figure 7-9).

The A6 Het-YIG Driver and A7, A8, and A9 YIG Driver PCBs provide tuning and bias currents for the Osc 1, 2, 3 and 4 YIG tuning coils. The tuning currents are derived from the three tuning voltages (**F CEN, ΔF >50 MHz, F CORR**) supplied by the A5 PCB. The oscillator bias currents are generated individually on the A6-A9 PCBs. In addition to tuning and bias currents, the A6 PCB also generates a tracking filter voltage, which is supplied to the A10 PCB. This voltage indirectly provides tuning for the YIG tracking filter that is built into the Osc 1 YIG module. With the exception of the Mod Driver signals previously described, the other A6-A9 outputs are control lines. The **SNB** and **SNR** lines are select-next-band and select-next-ROM lines, respectively. When the presently-selected oscillator has reached its upper-most frequency, the **SNB** line selects the next oscillator band and the **SNR** line enables this next oscillator band's linearizing ROM. The **HET YIG SEL** and **YIG 1, 2, 3,** and **4 FM COIL SEL** lines are supplied to the A10 PCB. An overall description of the A6-A9 PCBs is given in paragraph 7-12.2. The A6 PCB is described in paragraph 7-12.3 and the A7-A9 PCBs are described in paragraph 7-12.4.

The RF Deck is a subassembly; it contains all of the sweep generator RF components. This subassembly is described in paragraph 7-14.

f. Model 6642A. The model-dependent circuits and components for the 6642A consist of the A6 and A7 PCBs and the RF Deck components, as shown in Figure 7-6.

The A6 and A7 YIG Driver PCBs provide tuning and bias currents for the Osc 1 and 2 YIG tuning coils. The tuning currents are derived from the three tuning voltages (**F CEN, ΔF >50 MHz, F CORR**) supplied by the A5 PCB. The oscillator bias currents are generated individually on the A6 and A7 PCBs. With the exception of the MOD DRIVER signals previously described, the other A6 and A7 outputs are control lines. The **SNB** and **SNR** lines are select-next-band and select-next-ROM lines, respectively. When the presently-selected oscillator band has reached its upper-most frequency, the **SNB** line selects the next oscillator band and the **SNR** line enables this next oscillator band's linearizing ROM. The **YIG 1, 2, 3,** and **4 SEL** lines are supplied to the A10 PCB. An overall description of the A6/A7 PCBs is given in paragraph 7-12.2. The A6 PCB is described in paragraph 7-12.3 and the A7 PCB is described in paragraph 7-12.4.

The RF Deck is a subassembly; it contains all of the sweep generator RF components. This subassembly is described in paragraph 7-14.

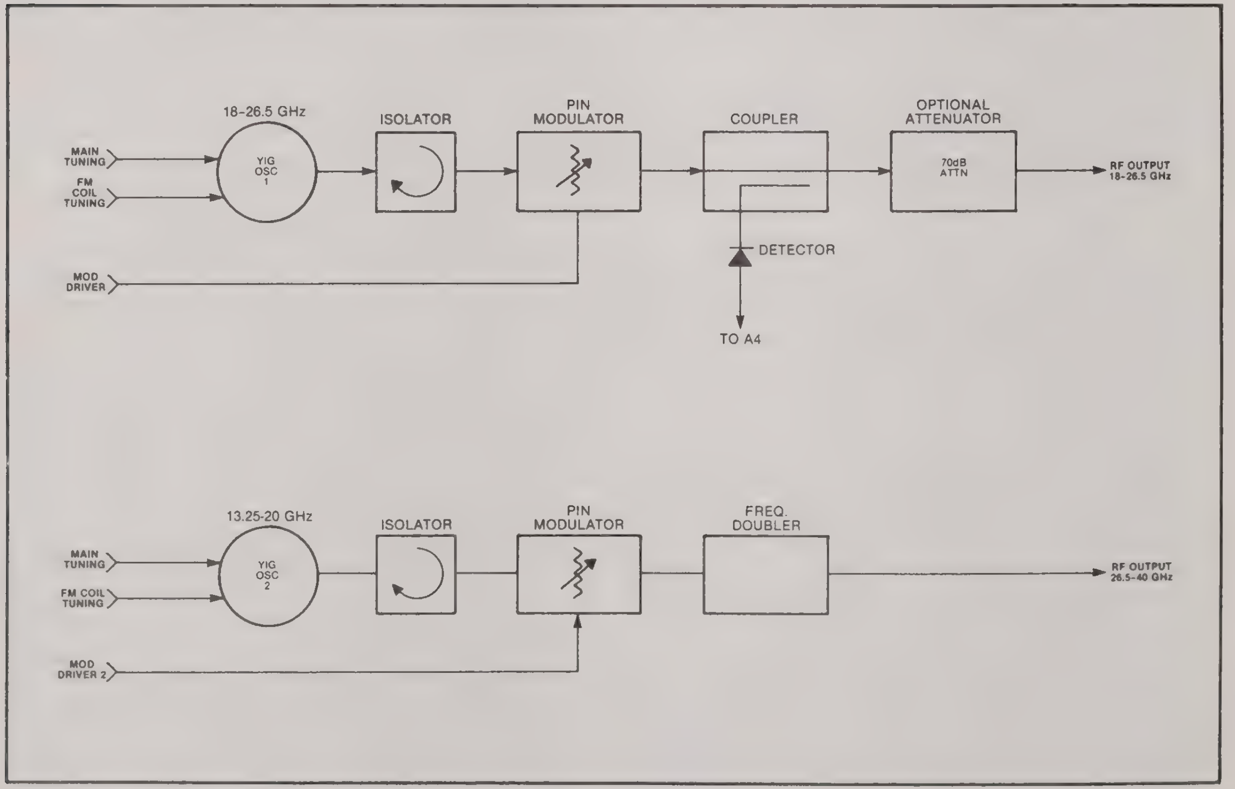

18-26.5 GHz
ISOLATOR
PIN MODULATOR
COUPLER
OPTIONAL ATTENUATOR
MAIN TUNING
FM COIL TUNING
YIG OSC 1
70dB ATTN
RF OUTPUT 18-26.5 GHz
DETECTOR
MOD DRIVER
TO A4
13.25-20 GHz
ISOLATOR
PIN MODULATOR
FREQ. DOUBLER
MAIN TUNING
FM COIL TUNING
YIG OSC 2
RF OUTPUT 26.5-40 GHz
MOD DRIVER 2

Figure 7-6. Model 6642A RF Components Deck

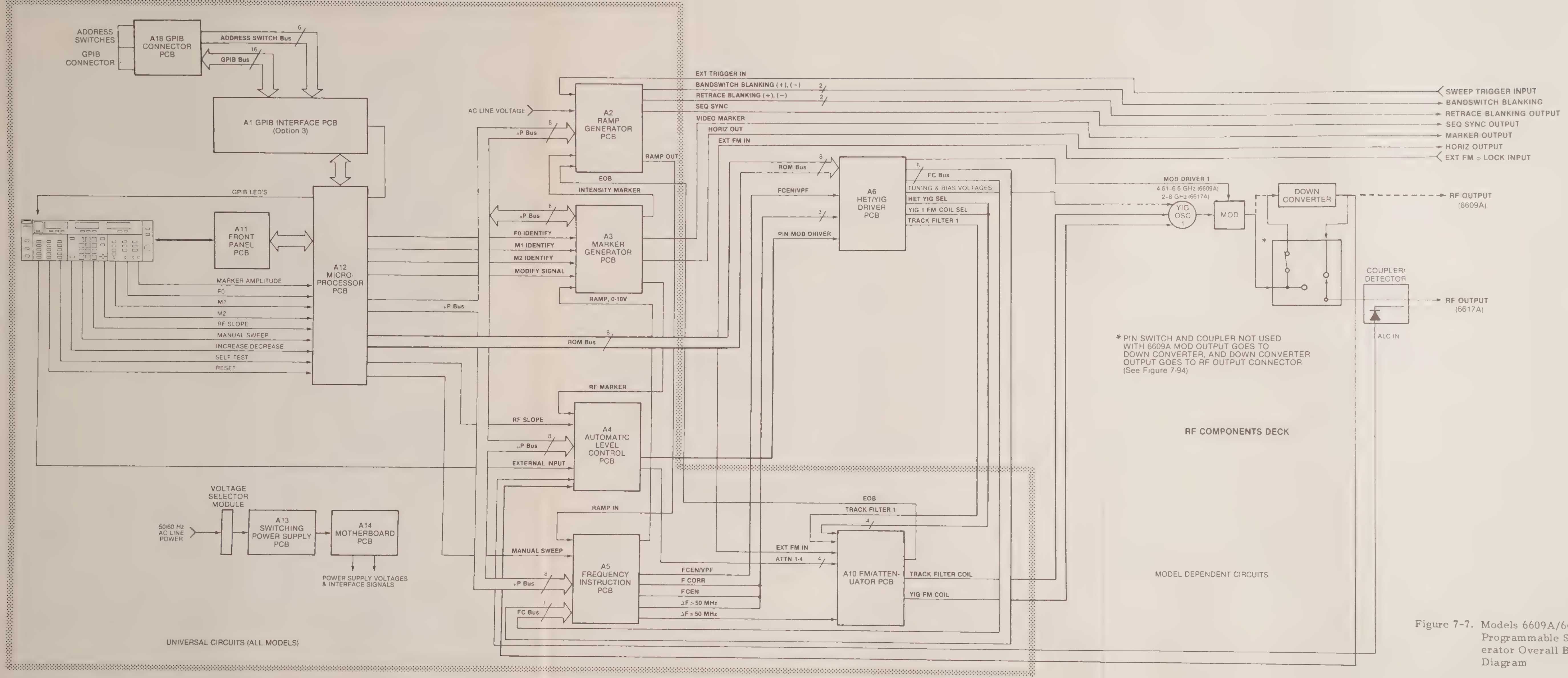
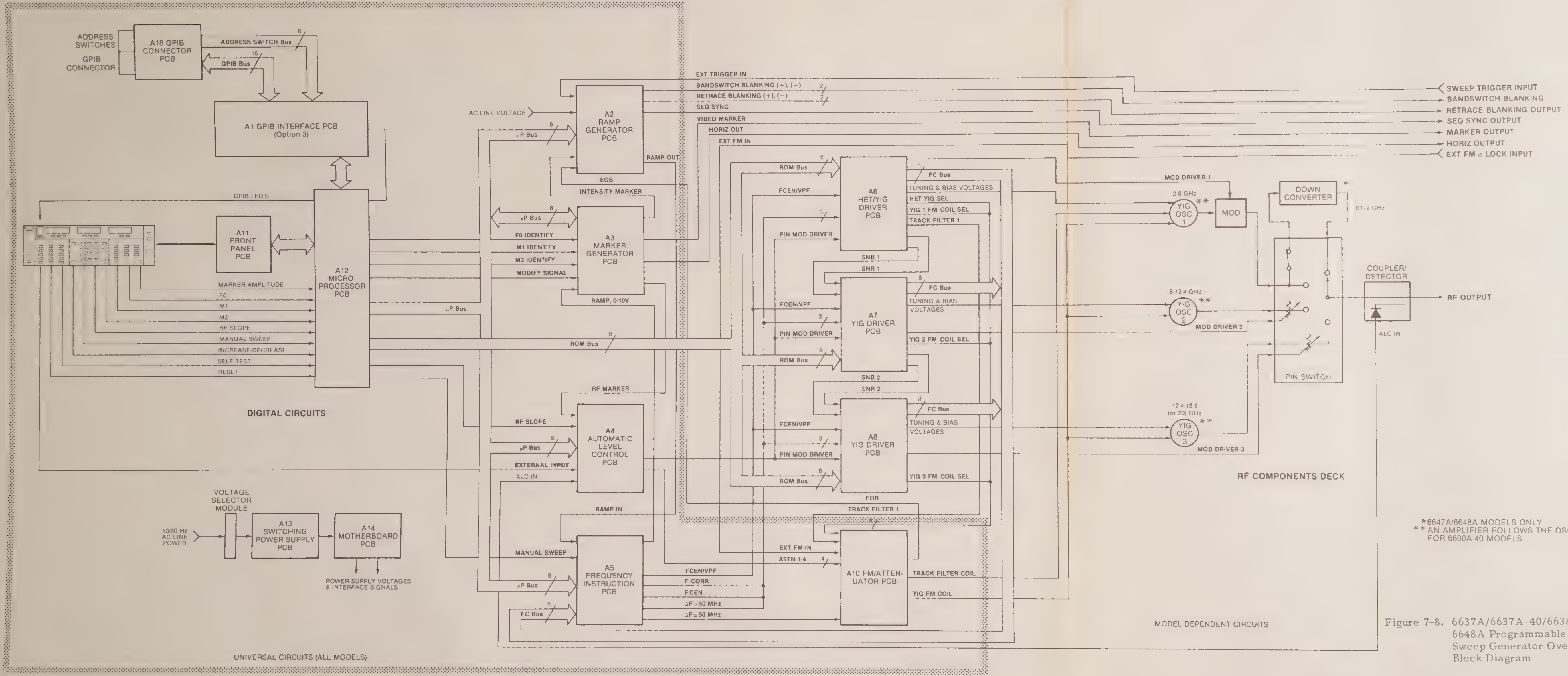

ADDRESS SWITCHES
GPIB CONNECTOR
A18 GPIB CONNECTOR PCB
ADDRESS SWITCH Bus
6
16
GPIB Bus
A1 GPIB INTERFACE PCB (Option 3)
GPIB LED'S
A11 FRONT PANEL PCB
A12 MICRO-PROCESSOR PCB
MARKER AMPLITUDE
F0
M1
M2
RF SLOPE
MANUAL SWEEP
INCREASE-DECREASE
SELF TEST
RESET
μP Bus
ROM Bus
AC LINE VOLTAGE
A2 RAMP GENERATOR PCB
RAMP OUT
EOB
INTENSITY MARKER
A3 MARKER GENERATOR PCB
F0 IDENTIFY
M1 IDENTIFY
M2 IDENTIFY
MODIFY SIGNAL
RAMP, 0-10V
RF MARKER
RF SLOPE
A4 AUTOMATIC LEVEL CONTROL PCB
EXTERNAL INPUT
RAMP IN
MANUAL SWEEP
A5 FREQUENCY INSTRUCTION PCB
FC Bus
FCEN/VPF
F CORR
FCEN
ΔF > 50 MHz
ΔF ≤ 50 MHz
EXT TRIGGER IN
BANDSWITCH BLANKING (+), (−)
RETRACE BLANKING (+), (−)
SEQ SYNC
VIDEO MARKER
HORIZ OUT
EXT FM IN
2
8
3
4
A6 HET/YIG DRIVER PCB
FCEN/VPF
PIN MOD DRIVER
FC Bus
TUNING & BIAS VOLTAGES
HET YIG SEL
YIG 1 FM COIL SEL
TRACK FILTER 1
EOB
TRACK FILTER 1
EXT FM IN
ATTN 1-4
A10 FM/ATTEN-UATOR PCB
TRACK FILTER COIL
YIG FM COIL
VOLTAGE SELECTOR MODULE
50/60 Hz AC LINE POWER
A13 SWITCHING POWER SUPPLY PCB
A14 MOTHERBOARD PCB
POWER SUPPLY VOLTAGES & INTERFACE SIGNALS
UNIVERSAL CIRCUITS (ALL MODELS)
MODEL DEPENDENT CIRCUITS
RF COMPONENTS DECK
SWEEP TRIGGER INPUT
BANDSWITCH BLANKING
RETRACE BLANKING OUTPUT
SEQ SYNC OUTPUT
MARKER OUTPUT
HORIZ OUTPUT
EXT FM ○ LOCK INPUT
MOD DRIVER 1
4.61-6.6 GHz (6609A)
2-8 GHz (6617A)
YIG OSC 1
MOD
DOWN CONVERTER
RF OUTPUT (6609A)
*
COUPLER/ DETECTOR
RF OUTPUT (6617A)
ALC IN
* PIN SWITCH AND COUPLER NOT USED WITH 6609A MOD OUTPUT GOES TO DOWN CONVERTER, AND DOWN CONVERTER OUTPUT GOES TO RF OUTPUT CONNECTOR (See Figure 7-94)

Figure 7-7. Models 6609A/6617A Programmable Sweep Generator Overall Block Diagram


ADDRESS SWITCHES
GPIB CONNECTOR
A18 GPIB CONNECTOR PCB
ADDRESS SWITCH Bus
6
GPIB Bus
16
A1 GPIB INTERFACE PCB (Option 3)
GPIB LED'S
A11 FRONT PANEL PCB
A12 MICRO-PROCESSOR PCB
MARKER AMPLITUDE
F0
M1
M2
RF SLOPE
MANUAL SWEEP
INCREASE-DECREASE
SELF TEST
RESET
DIGITAL CIRCUITS
VOLTAGE SELECTOR MODULE
50/60 Hz AC LINE POWER
A13 SWITCHING POWER SUPPLY PCB
A14 MOTHERBOARD PCB
POWER SUPPLY VOLTAGES & INTERFACE SIGNALS
UNIVERSAL CIRCUITS (ALL MODELS)
AC LINE VOLTAGE
μP Bus
8
A2 RAMP GENERATOR PCB
RAMP OUT
EOB
INTENSITY MARKER
F0 IDENTIFY
M1 IDENTIFY
M2 IDENTIFY
MODIFY SIGNAL
A3 MARKER GENERATOR PCB
RAMP, 0-10V
μP Bus
ROM Bus
8
RF MARKER
RF SLOPE
μP Bus
EXTERNAL INPUT
ALC IN
A4 AUTOMATIC LEVEL CONTROL PCB
RAMP IN
MANUAL SWEEP
μP Bus
FC Bus
A5 FREQUENCY INSTRUCTION PCB
FCEN/VPF
F CORR
FCEN
ΔF > 50 MHz
ΔF ≤ 50 MHz
EXT TRIGGER IN
BANDSWITCH BLANKING (+), (−)
2
RETRACE BLANKING (+), (−)
2
SEQ SYNC
VIDEO MARKER
HORIZ OUT
EXT FM IN
ROM Bus
FCEN/VPF
3
PIN MOD DRIVER
A6 HET/YIG DRIVER PCB
FC Bus
TUNING & BIAS VOLTAGES
HET YIG SEL
YIG 1 FM COIL SEL
TRACK FILTER 1
SNB 1
SNR 1
FCEN/VPF
PIN MOD DRIVER
ROM Bus
A7 YIG DRIVER PCB
FC Bus
TUNING & BIAS VOLTAGES
YIG 2 FM COIL SEL
SNB 2
SNR 2
FCEN/VPF
PIN MOD DRIVER
ROM Bus
A8 YIG DRIVER PCB
FC Bus
TUNING & BIAS VOLTAGES
YIG 3 FM COIL SEL
EOB
TRACK FILTER 1
EXT FM IN
ATTN 1-4
4
A10 FM/ATTEN-UATOR PCB
TRACK FILTER COIL
YIG FM COIL
MODEL DEPENDENT CIRCUITS
SWEEP TRIGGER INPUT
BANDSWITCH BLANKING
RETRACE BLANKING OUTPUT
SEQ SYNC OUTPUT
MARKER OUTPUT
HORIZ OUTPUT
EXT FM ⌀ LOCK INPUT
MOD DRIVER 1
2-8 GHz
YIG OSC 1
**
MOD
DOWN CONVERTER
*
01-2 GHz
8-12.4 GHz
YIG OSC 2
MOD DRIVER 2
12.4-18.6 (or 20) GHz
YIG OSC 3
MOD DRIVER 3
PIN SWITCH
COUPLER/ DETECTOR
ALC IN
RF OUTPUT
RF COMPONENTS DECK

*6647A/6648A MODELS ONLY
** AN AMPLIFIER FOLLOWS THE OSCILLATOR FOR 6600A-40 MODELS

Figure 7-8. 6637A/6637A-40/6638A/6647A/6648A Programmable Sweep Generator Overall Block Diagram

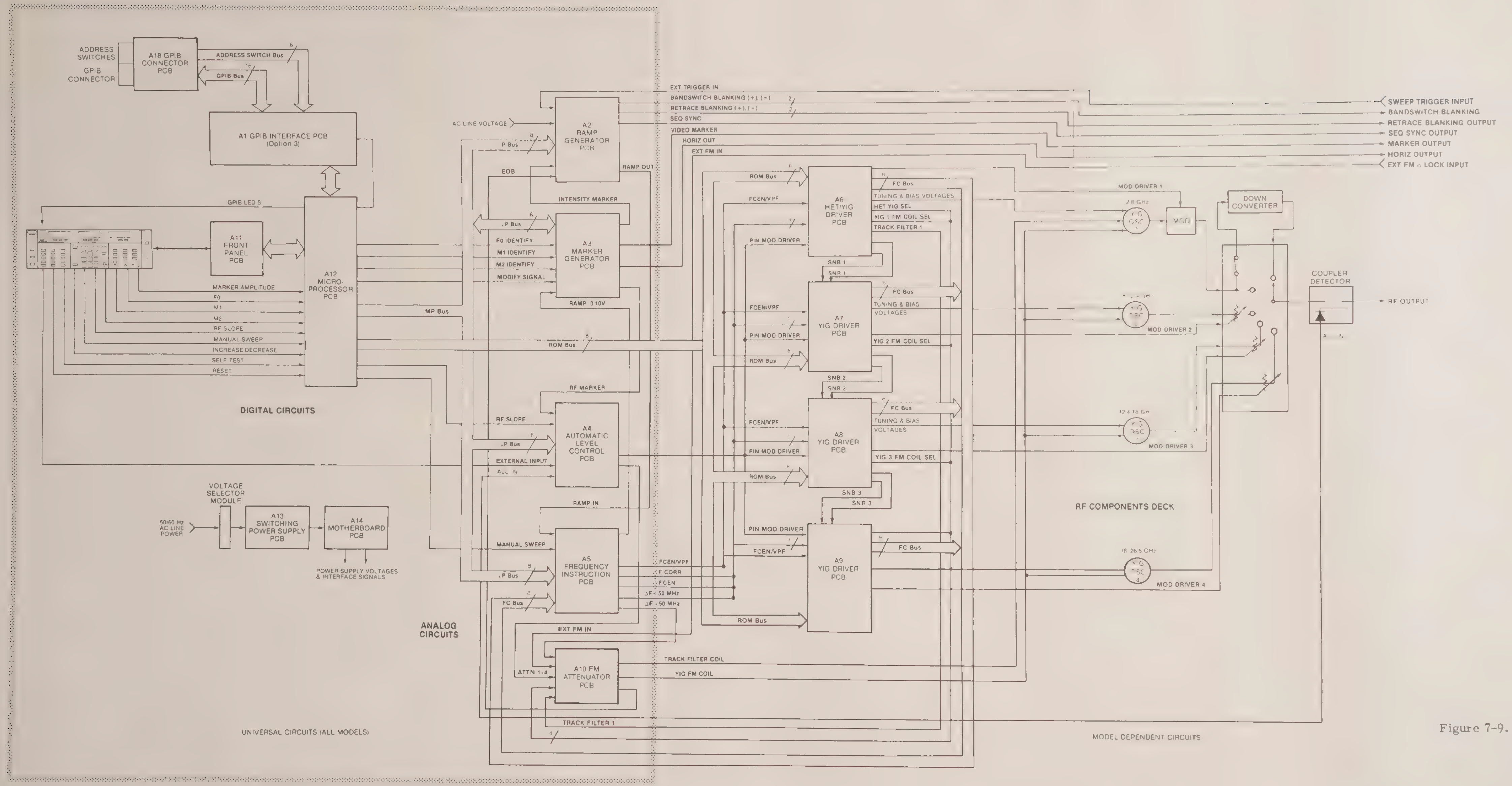

ADDRESS SWITCHES
GPIB CONNECTOR
A18 GPIB CONNECTOR PCB
ADDRESS SWITCH Bus
6
GPIB Bus
16
A1 GPIB INTERFACE PCB (Option 3)
GPIB LED S
A11 FRONT PANEL PCB
A12 MICRO-PROCESSOR PCB
MARKER AMPLITUDE
F0
M1
M2
RF SLOPE
MANUAL SWEEP
INCREASE DECREASE
SELF TEST
RESET
MP Bus
ROM Bus
DIGITAL CIRCUITS
AC LINE VOLTAGE
P Bus
EOB
A2 RAMP GENERATOR PCB
RAMP OUT
INTENSITY MARKER
P Bus
F0 IDENTIFY
M1 IDENTIFY
M2 IDENTIFY
MODIFY SIGNAL
A3 MARKER GENERATOR PCB
RAMP 0 10V
RF MARKER
RF SLOPE
P Bus
EXTERNAL INPUT
A4 AUTOMATIC LEVEL CONTROL PCB
RAMP IN
MANUAL SWEEP
P Bus
FC Bus
A5 FREQUENCY INSTRUCTION PCB
FCEN/VPF
F CORR
FCEN
ΔF < 50 MHz
ΔF > 50 MHz
EXT FM IN
ATTN 1-4
A10 FM ATTENUATOR PCB
TRACK FILTER COIL
YIG FM COIL
TRACK FILTER 1
VOLTAGE SELECTOR MODULE
50/60 Hz AC LINE POWER
A13 SWITCHING POWER SUPPLY PCB
A14 MOTHERBOARD PCB
POWER SUPPLY VOLTAGES & INTERFACE SIGNALS
ANALOG CIRCUITS
UNIVERSAL CIRCUITS (ALL MODELS)
EXT TRIGGER IN
BANDSWITCH BLANKING (+), (−)
RETRACE BLANKING (+), (−)
SEQ SYNC
VIDEO MARKER
HORIZ OUT
EXT FM IN
ROM Bus
FCEN/VPF
PIN MOD DRIVER
A6 HET/YIG DRIVER PCB
FC Bus
TUNING & BIAS VOLTAGES
HET YIG SEL
YIG 1 FM COIL SEL
TRACK FILTER 1
SNB 1
SNR 1
A7 YIG DRIVER PCB
YIG 2 FM COIL SEL
SNB 2
SNR 2
A8 YIG DRIVER PCB
YIG 3 FM COIL SEL
SNB 3
SNR 3
A9 YIG DRIVER PCB
SWEEP TRIGGER INPUT
BANDSWITCH BLANKING
RETRACE BLANKING OUTPUT
SEQ SYNC OUTPUT
MARKER OUTPUT
HORIZ OUTPUT
EXT FM ○ LOCK INPUT
MOD DRIVER 1
2-8 GHz
YIG OSC
MOD
DOWN CONVERTER
MOD DRIVER 2
12.4-18 GHz
MOD DRIVER 3
18-26.5 GHz
MOD DRIVER 4
COUPLER DETECTOR
RF OUTPUT
RF COMPONENTS DECK
MODEL DEPENDENT CIRCUITS

Figure 7-9. Models 6653A/6659A Programmable Sweep Generator Overall Block Diagram

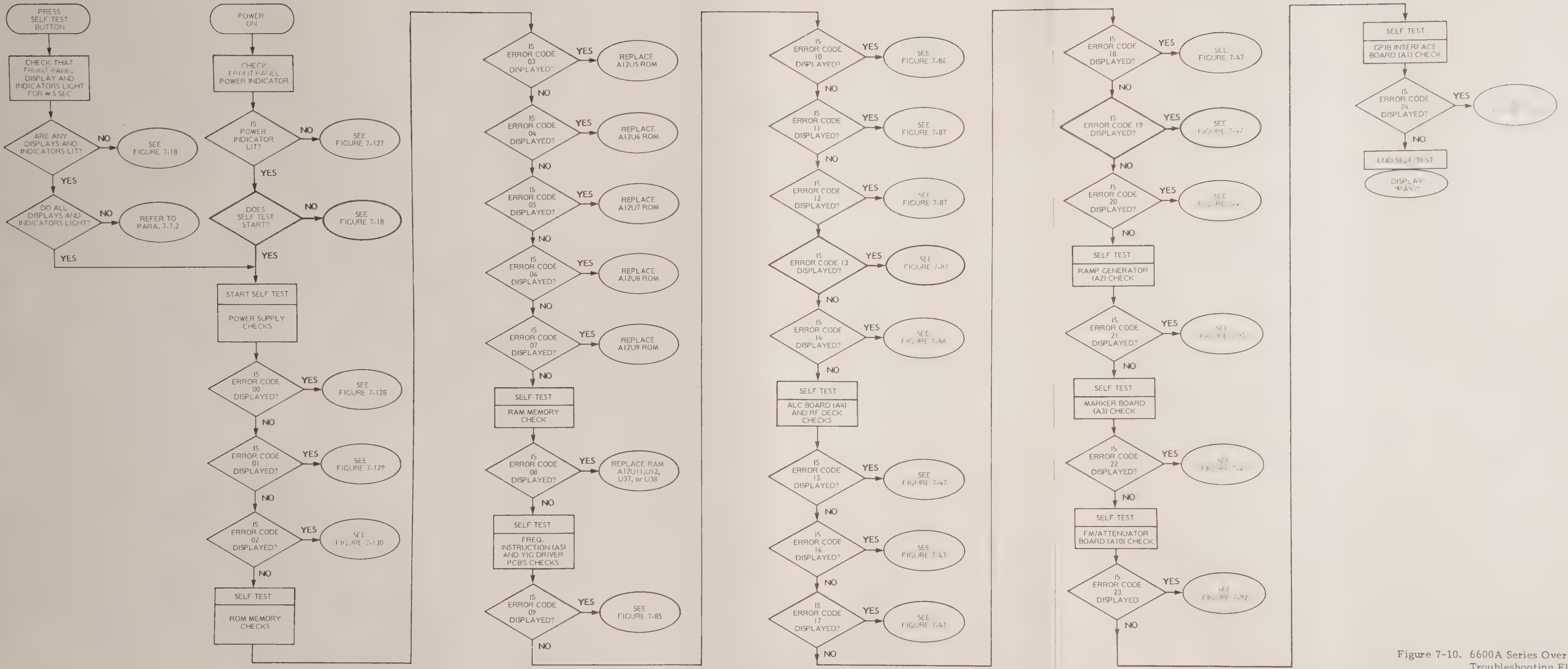

PRESS SELF TEST BUTTON
CHECK THAT FRONT PANEL DISPLAY AND INDICATORS LIGHT FOR ≈ 5 SEC
ARE ANY DISPLAYS AND INDICATORS LIT?
NO
SEE FIGURE 7-18
YES
DO ALL DISPLAYS AND INDICATORS LIGHT?
NO
REFER TO PARA. 7-7.2
YES
POWER ON
CHECK FRONT PANEL POWER INDICATOR
IS POWER INDICATOR LIT?
NO
SEE FIGURE 7-127
YES
DOES SELF TEST START?
NO
SEE FIGURE 7-18
YES
START SELF TEST
POWER SUPPLY CHECKS
IS ERROR CODE 00 DISPLAYED?
YES
SEE FIGURE 7-128
NO
IS ERROR CODE 01 DISPLAYED?
YES
SEE FIGURE 7-129
NO
IS ERROR CODE 02 DISPLAYED?
YES
SEE FIGURE 7-130
NO
SELF TEST
ROM MEMORY CHECKS
IS ERROR CODE 03 DISPLAYED?
YES
REPLACE A12U5 ROM
NO
IS ERROR CODE 04 DISPLAYED?
YES
REPLACE A12U6 ROM
NO
IS ERROR CODE 05 DISPLAYED?
YES
REPLACE A12U7 ROM
NO
IS ERROR CODE 06 DISPLAYED?
YES
REPLACE A12U8 ROM
NO
IS ERROR CODE 07 DISPLAYED?
YES
REPLACE A12U9 ROM
NO
SELF TEST
RAM MEMORY CHECK
IS ERROR CODE 08 DISPLAYED?
YES
REPLACE RAM A12U11,U12, U37, or U38
NO
SELF TEST
FREQ. INSTRUCTION (A5) AND YIG DRIVER PCB'S CHECKS
IS ERROR CODE 09 DISPLAYED?
YES
SEE FIGURE 7-85
NO
IS ERROR CODE 10 DISPLAYED?
YES
SEE FIGURE 7-86
NO
IS ERROR CODE 11 DISPLAYED?
YES
SEE FIGURE 7-87
NO
IS ERROR CODE 12 DISPLAYED?
YES
SEE FIGURE 7-87
IS ERROR CODE 13 DISPLAYED?
YES
SEE FIGURE 7-87
NO
IS ERROR CODE 14 DISPLAYED?
YES
SEE FIGURE 7-88
NO
SELF TEST
ALC BOARD (A4) AND RF DECK CHECKS
IS ERROR CODE 15 DISPLAYED?
YES
SEE FIGURE 7-47
NO
IS ERROR CODE 16 DISPLAYED?
YES
SEE FIGURE 7-47
NO
IS ERROR CODE 17 DISPLAYED?
YES
SEE FIGURE 7-47
NO
IS ERROR CODE 18 DISPLAYED?
YES
SEE FIGURE 7-47
NO
IS ERROR CODE 19 DISPLAYED?
YES
SEE FIGURE 7-47
NO
IS ERROR CODE 20 DISPLAYED?
YES
SEE
NO
SELF TEST
RAMP GENERATOR (A2) CHECK
IS ERROR CODE 21 DISPLAYED?
YES
SEE
NO
SELF TEST
MARKER BOARD (A3) CHECK
IS ERROR CODE 22 DISPLAYED?
YES
SEE
NO
SELF TEST
FM/ATTENUATOR BOARD (A10) CHECK
IS ERROR CODE 23 DISPLAYED
YES
SEE FIGURE 7-92
NO
SELF TEST
GPIB INTERFACE BOARD (A1) CHECK
IS ERROR CODE 24 DISPLAYED?
YES
NO
END SELF TEST
DISPLAY "PASS"

Figure 7-10. 6600A Series Overall Troubleshooting Flowchart

7-5 6600A SERIES PROGRAMMABLE SWEEP GENERATOR, OVERALL TROUBLESHOOTING

Troubleshooting for the 6600A Series Sweep Generators is facilitated by the self-test error codes described in paragraph 3-4. When used with the supplemental flowcharts and block diagrams provided in this section, these error codes can be used to isolate most malfunctions to the defective functional or integrated circuit. A flowchart for troubleshooting the self-test error codes is provided in Figure 7-10 (facing page).

7-6 A12 MICROPROCESSOR PCB

7-6.1 A12 Microprocessor PCB, Circuit Description

The A12 Microprocessor PCB controls the operation of the sweep generator. It also provides, via the A11 Front Panel PCB, the interface between the front panel pushbuttons and the analog sweep- and microwave-generating circuitry. To provide this control, the A12 PCB contains an 8085 Microprocessor integrated circuit (IC), an 8279 Keyboard/Display Interface IC, 10k bytes of read-only memory (ROM), and 512 bytes of read/write memory (RAM). A block diagram of the A12 PCB circuitry is provided in Figure 7-11. A diagram showing the distribution of control-group data between the A12 PCB and the A2-A5 and A14 PCBs is provided in Figure 7-12; descriptions of these data are provided in Appendix III. A flowchart showing the microprocessor's ac power-on operational program is provided in Figure 7-13. A parts locator diagram for the A12 PCB is provided in Figure 7-14. And the A12 PCB schematics (5 sheets) are provided in Figure 7-15.

The 8279 IC (U25) (Figure 7-11) interfaces the microprocessor with the front panel pushbuttons and numeric displays. This IC, via its scan lines (the **SL0-SL3 &L CAD Bus**), causes the front panel pushbuttons and numeric-display digits to be continually scanned. When the user selects a pushbutton, an 8-bit digitally coded word (keycode) representing that pushbutton is sent over the **COL1-COL8 Bus** to the keyboard controller (8279), and eventually to the microprocessor. Conversely, when the microprocessor selects a numeric display for update, a likewise-coded word representing the display segment is sent over the **NA0-NA3/NB0-NB3 Bus** to one of the three displays.

The Latch (U31) and Flash Logic (U34, U35) circuits interface the microprocessor with the EXTERNAL ALC GAIN CAL (ALC CAL), SWEEPING, RF OFF, and UNLEVELED (flashing) front panel LEDs. The interface with the other (non-flashing) LEDs is via the data bus and six latches on the A11 PCB.

The Bidirectional Buffer #2 circuit (U13) interfaces the microprocessor with analog PCBs A2-A5, ROM Bus latch A14U6, and diagnostic (self-test) latches A14U7, U8, and U10 – all on the motherboard. Also, if Option 3 is installed, U13 interfaces the microprocessor with the A1 GPIB Interface PCB.

The Control Signal Input Ports (U29, U30) are latch/buffers that allow control signal data from the A2, A3, and A4 analog PCBs, the A1 GPIB Interface PCB (Option 3 only), and the A11 Front Panel PCB to be input into the microprocessor.

The Bidirectional Buffer #1 circuit (U14) buffers the input/output interface circuitry from the microprocessor "kernel," the control element on the A12 PCB. This kernel consists of:

a. 8085 Microprocessor (U2). U2 is a complete central-processing unit (CPU); it contains all of the necessary registers, plus the arithmetic logic unit (ALU) and control circuitry.

b. Address Decoders (U3, U4). U3 and U4 decode the A8-A14 and A0-A7 address lines, providing addresses for the memory circuits.

c. 5101 RAM (U11, U12, U37, U38), RAM Buffer (U10), and RAM Battery (B1, U1). The RAM circuits store the data input via the front panel pushbuttons. The RAM Battery provides operating power for the read/write memory when the ac power is turned off, making this memory nonvolatile.

d. 2716 ROM (U5-U9). The ROM circuits contain both the microprocessor ac power-on operational program (Figure 7-13) and the reset (default) parameter data (paragraph 3-7.1).

e. Free-Run Socket (J9). J9 provides for testing of the microprocessor. The removal of J9 forces a series of no-operation (NOP) instructions on the microprocessor, thus causing it to free-run.

f. Port Decoders (U18-U23). The port decoders are divided between input and output ports. U19-U21 are output port decoders, U22 and U23 are input port decoders, and U18 is a port-decoder-enable circuit.

U19-U21 decode the microprocessor output-port data and select one of 24 output ports. The selected port then receives the data that the microprocessor has concurrently sent over the data bus. The output-port-select lines are **SP0** thru **SP23**. The **SP0-SP15** lines go to the analog PCB ports, located on the individual A2-A5 and A14 PCBs (Figure 7-12). **SP16-SP21** go to the front-panel non-flashing LED ports, A11U1 thru A11U6. The **SP22** line goes to the front-panel flashing LED port, A12U31. And the **SP23** line goes to the GPIB Interface PCB μP-data input port, A1U22 (Option 3 only).

U22 and U23 decode the microprocessor input-port data and select one of the eight latch/buffer circuit input ports. When selected, the port then allows the data that is concurrently on the A14 **μP Data Bus** to be input into the microprocessor. The input port data is divided into four types: diagnostics (self-test) data, GPIB data (Option 3 only), INCREASE/DECREASE lever frequency data, and control-signal data. Input port select lines **SX1**, **SX2**, and **SX7** select the diagnostics data; **SX3** selects the GPIB data; **SX4** and **SX29** select the INCREASE/DECREASE lever frequency data; and **SX24** and **SX25** select the control-signal data.

g. SERVICE-NORMAL Switch **(S1)**. In the SERVICE position, S1 interrupts the microprocessor and causes it to run a stimulus routine for signature-analysis testing.

The A14 Motherboard PCB components that are functionally part of the microprocessor circuitry consist of the Linearizer ROM Latch, A14U6, and the Diagnostic (Self Test) Latches A14U7, U8, and U10.

The Linearizer-ROM Latch, U6, supplies address data to the linearizer ROMs located on the A6, A7, A8, and A9 YIG Driver PCBs. When clocked by SP5, U5 latches the microprocessor-supplied ROM address data from its input to its output circuit. The output-circuit data is supplied to each of the YIG driver PCBs, via the ROM bus.

The Diagnostic (Self Test) and Misc'l Signal Buffers, U7, U8, and U10, are respectively enabled by the **SX1**, **SX2**, and **SX7** input-port select lines from the microprocessor. When a buffer is enabled, the data that has been latched into its input circuit is allowed to pass to its output circuit. The input lines to the diagnostic buffers are as follows:

h. U7 Buffer:

1. **L YIG 1 SEL**, from A6 PCB.
2. **L YIG 2 SEL**, from A7 PCB.
3. **L YIG 3 SEL**, from A8 PCB.
4. **L YIG 4 SEL**, from A9.
5. **H SNR 1**, from A6 PCB.
6. **H SNR 2**, from A7 PCB.
7. **H SNR 3**, from A8 PCB.
8. **H SNR 4**, from A9.

i. U8 Buffer:

1. **H DWELL**, from A2 PCB.
2. **L HET YIG SEL**, from A6 PCB.
3. **H FM DIAG**, from A10 PCB.

j. U10 Buffer:

1. **L OR**, from A14U5 (switching power supply).
2. **L HL**, from A14U5 (switching power supply).

Para. 7-6.1 (cont'd.)

3. **L LL**, from A14U5 (switching power supply).
4. **GPIB IN**, from A1 PCB (Option 3).
5. **L DWELL DETECTED**, from A2 PCB.
6. **HORIZ OUTPUT DURING CW**, from XA16 connector.

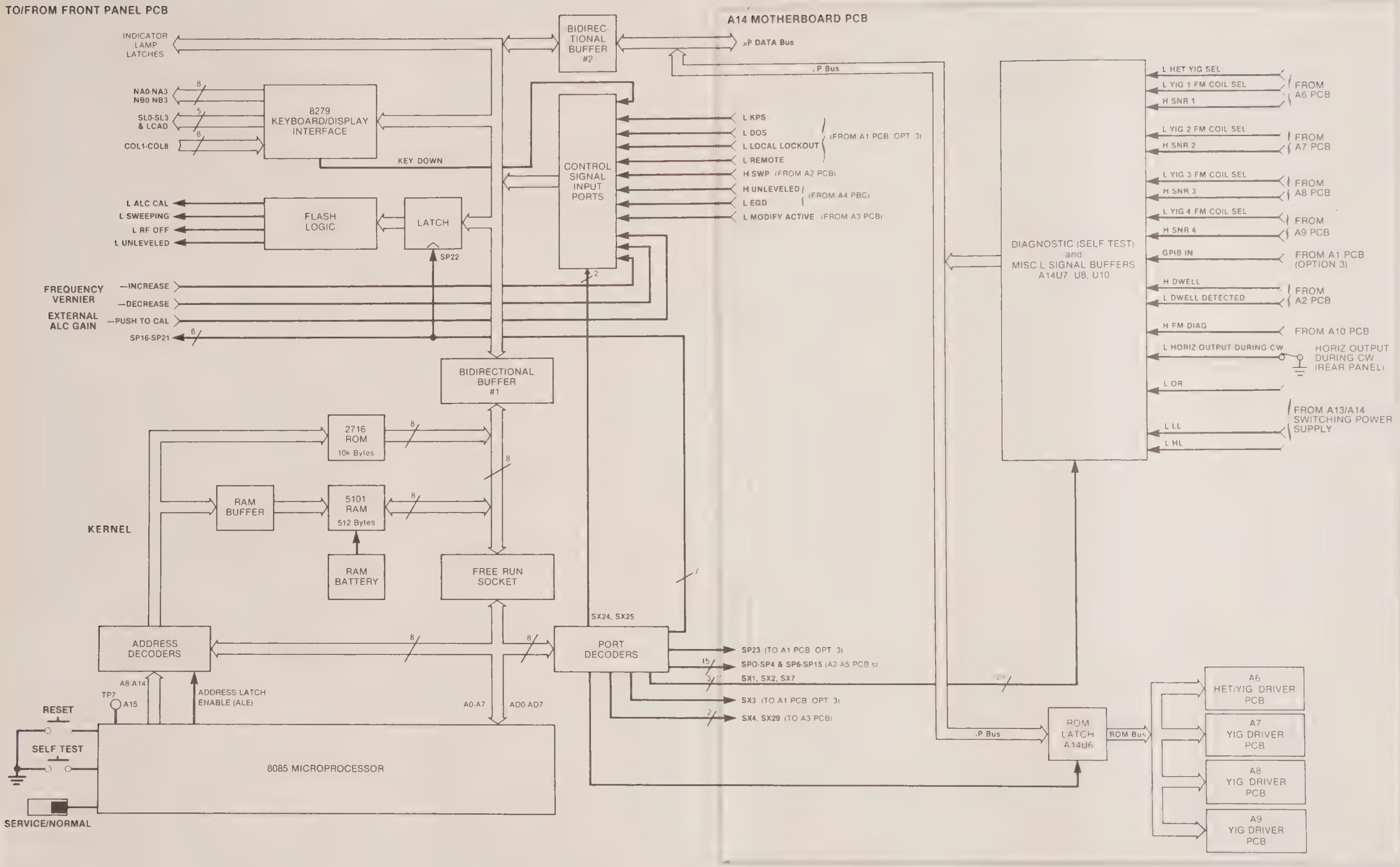

TO/FROM FRONT PANEL PCB
INDICATOR LAMP LATCHES
NA0-NA3 NB0 NB3
SL0-SL3 & LCAD
COL1-COL8
8
5
8
8279 KEYBOARD/DISPLAY INTERFACE
KEY DOWN
L ALC CAL
L SWEEPING
L RF OFF
L UNLEVELED
FLASH LOGIC
LATCH
SP22
FREQUENCY VERNIER
—INCREASE
—DECREASE
EXTERNAL ALC GAIN
—PUSH TO CAL
SP16-SP21
6
BIDIREC-TIONAL BUFFER #2
CONTROL SIGNAL INPUT PORTS
2
BIDIRECTIONAL BUFFER #1
2716 ROM 10k Bytes
RAM BUFFER
5101 RAM 512 Bytes
RAM BATTERY
FREE RUN SOCKET
KERNEL
ADDRESS DECODERS
PORT DECODERS
SX24, SX25
7
A8 A14
TP7
A15
ADDRESS LATCH ENABLE (ALE)
A0-A7
AD0-AD7
RESET
SELF TEST
SERVICE/NORMAL
8085 MICROPROCESSOR
A14 MOTHERBOARD PCB
μP DATA Bus
μP Bus
L KPS
L DOS
L LOCAL LOCKOUT
L REMOTE
(FROM A1 PCB OPT 3)
H SWP (FROM A2 PCB)
H UNLEVELED
L EGD
(FROM A4 PBC)
L MODIFY ACTIVE (FROM A3 PCB)
DIAGNOSTIC (SELF TEST) and MISC L SIGNAL BUFFERS A14U7 U8, U10
L HET YIG SEL
L YIG 1 FM COIL SEL
H SNR 1
FROM A6 PCB
L YIG 2 FM COIL SEL
H SNR 2
FROM A7 PCB
L YIG 3 FM COIL SEL
H SNR 3
FROM A8 PCB
L YIG 4 FM COIL SEL
H SNR 4
FROM A9 PCB
GPIB IN
FROM A1 PCB (OPTION 3)
H DWELL
L DWELL DETECTED
FROM A2 PCB
H FM DIAG
FROM A10 PCB
L HORIZ OUTPUT DURING CW
HORIZ OUTPUT DURING CW (REAR PANEL)
L OR
L LL
L HL
FROM A13/A14 SWITCHING POWER SUPPLY
SP23 (TO A1 PCB OPT 3)
SP0-SP4 & SP6-SP15 (A2-A5 PCB s)
15
SX1, SX2, SX7
3
SX3 (TO A1 PCB OPT 3)
SX4, SX29 (TO A3 PCB)
2
μP Bus
ROM LATCH A14U6
ROM Bus
A6 HET/YIG DRIVER PCB
A7 YIG DRIVER PCB
A8 YIG DRIVER PCB
A9 YIG DRIVER PCB

Figure 7-11. Microprocessor Overall Block Diagram

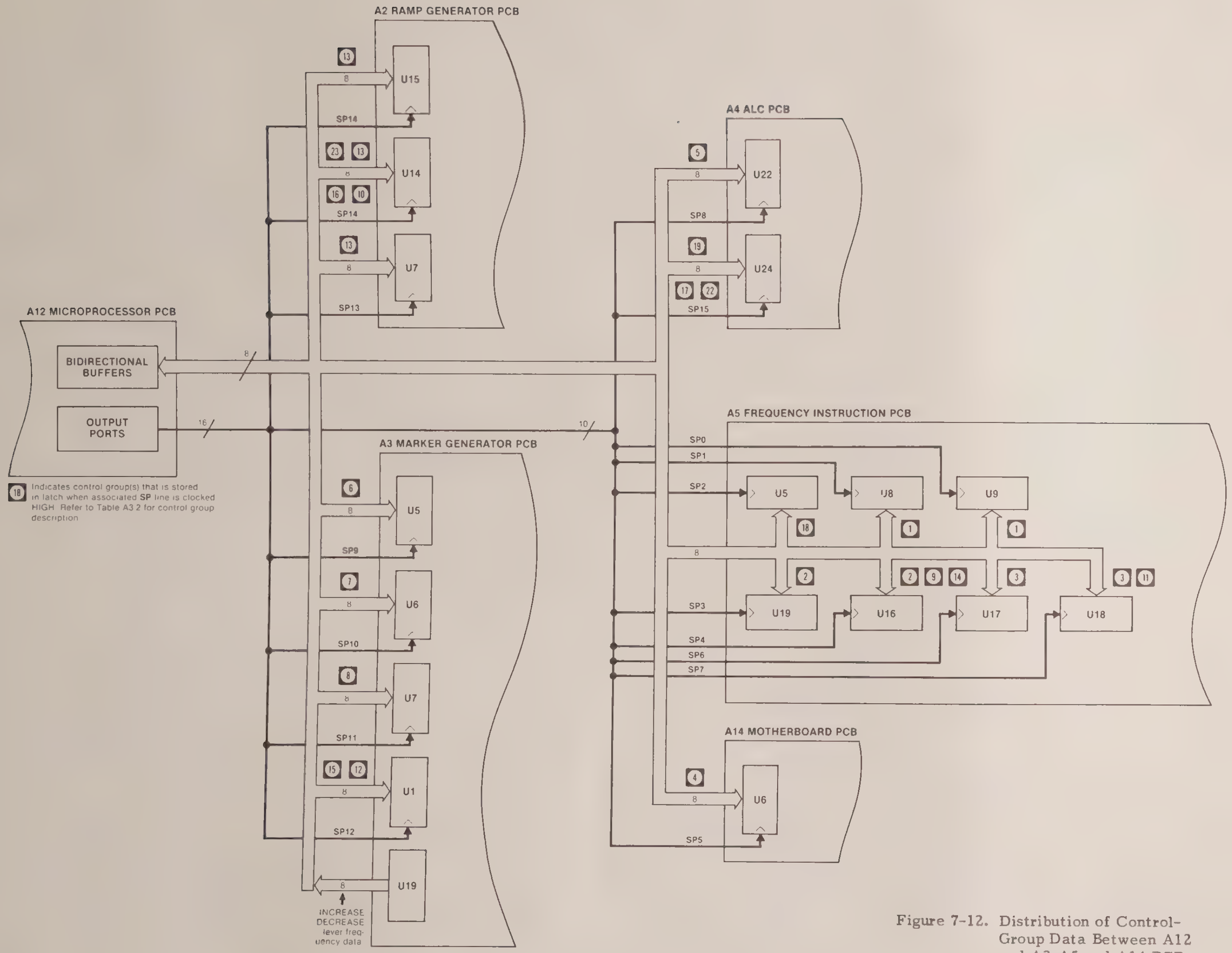

A2 RAMP GENERATOR PCB
13
8
U15
SP14
23
13
8
U14
16
10
SP14
13
8
U7
SP13
A4 ALC PCB
5
8
U22
SP8
19
8
U24
17
22
SP15
A12 MICROPROCESSOR PCB
BIDIRECTIONAL BUFFERS
OUTPUT PORTS
8
16
10
A5 FREQUENCY INSTRUCTION PCB
SP0
SP1
SP2
U5
U8
U9
18
1
1
8
2
2
9
14
3
3
11
SP3
U19
U16
U17
U18
SP4
SP6
SP7
A3 MARKER GENERATOR PCB
6
8
U5
SP9
7
8
U6
SP10
8
8
U7
SP11
15
12
8
U1
SP12
8
U19
INCREASE DECREASE lever frequency data
A14 MOTHERBOARD PCB
4
8
U6
SP5
18 Indicates control group(s) that is stored in latch when associated SP line is clocked HIGH. Refer to Table A3.2 for control group description

Figure 7-12. Distribution of Control-Group Data Between A12 and A2-A5 and A14 PCBs

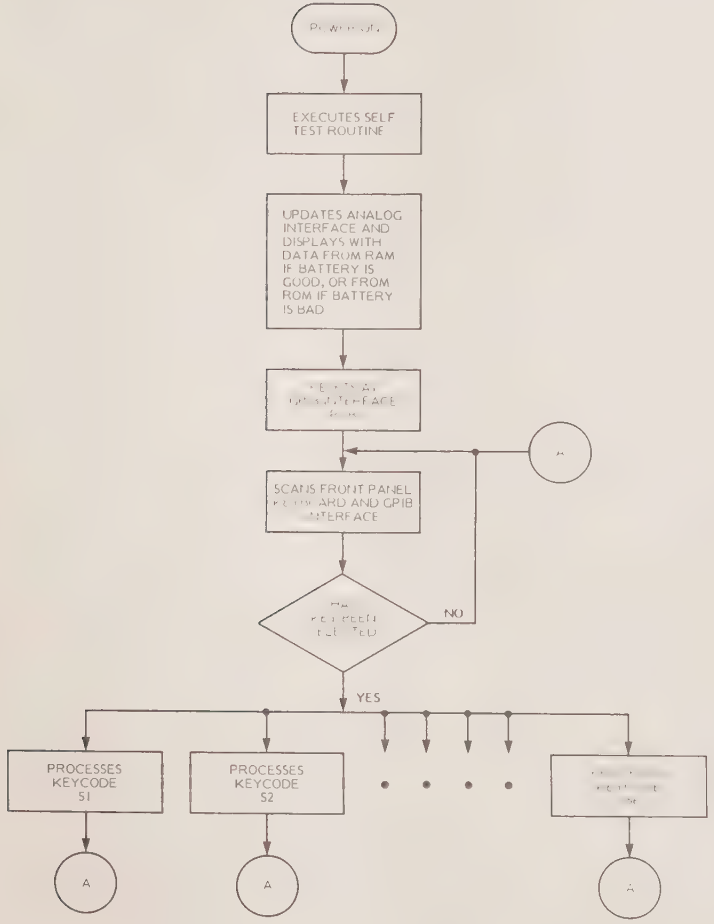

POWER ON
EXECUTES SELF TEST ROUTINE
UPDATES ANALOG INTERFACE AND DISPLAYS WITH DATA FROM RAM IF BATTERY IS GOOD, OR FROM ROM IF BATTERY IS BAD
A
SCANS FRONT PANEL KEYBOARD AND GPIB INTERFACE
HAS KEY BEEN DETECTED
NO
YES
PROCESSES KEYCODE S1
PROCESSES KEYCODE S2
A
A
A

Figure 7-13. A12 Microprocessor PCB AC Power-On Operational Flowchart

Figure 7-12

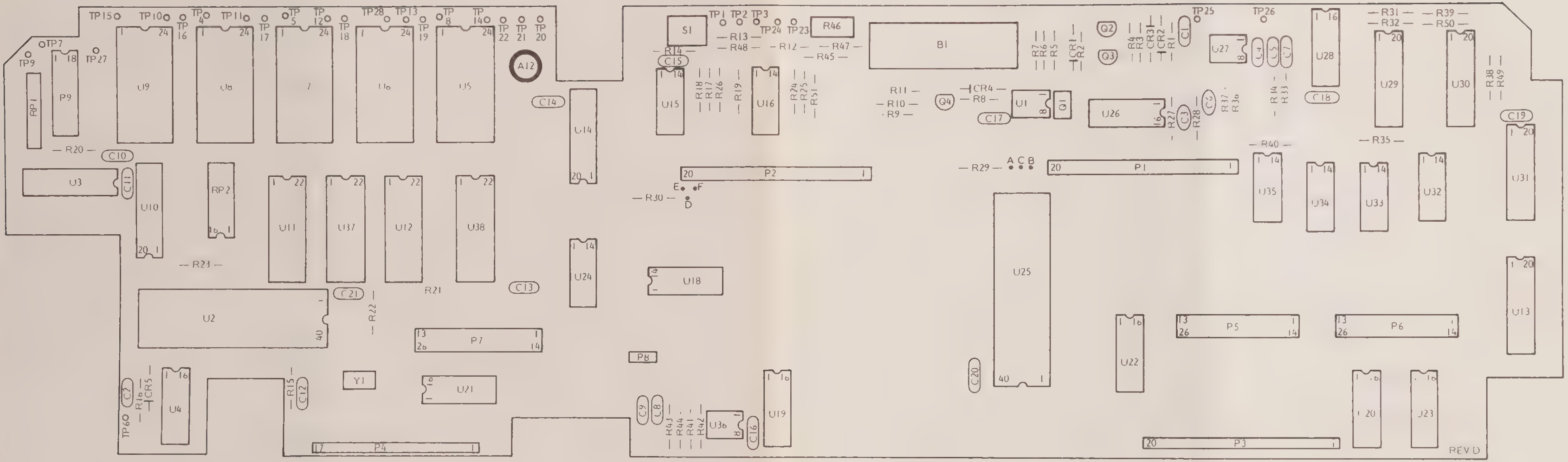
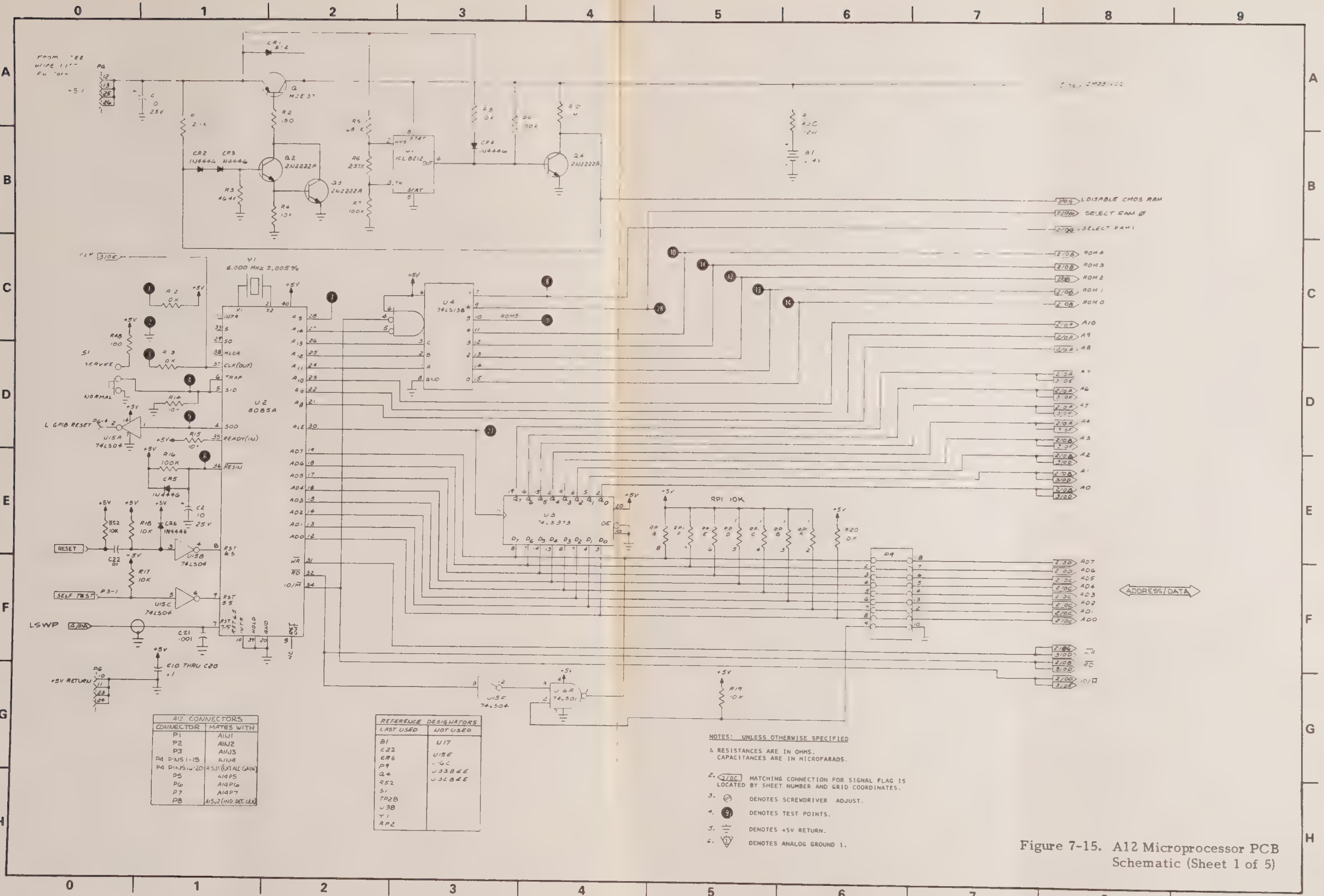

A12
TP1
TP2
TP3
TP4
TP5
TP7
TP8
TP9
TP10
TP11
TP12
TP13
TP14
TP15
TP16
TP17
TP18
TP19
TP20
TP21
TP22
TP23
TP24
TP25
TP26
TP27
TP28
TP60
RP1
RP2
P1
P2
P3
P4
P5
P6
P7
P8
P9
S1
B1
Y1
Q1
Q2
Q3
Q4
U1
U2
U3
U4
U5
U6
U8
U9
U10
U11
U12
U13
U14
U15
U16
U18
U19
U21
U22
U23
U24
U25
U26
U27
U28
U29
U30
U31
U32
U33
U34
U35
U36
U37
U38
C1
C3
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
CR1
CR2
CR3
CR4
CR5
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38
R39
R40
R41
R42
R43
R44
R45
R46
R47
R48
R49
R50
R51
A C B
E
F
D
REV D

Figure 7-14. A12 Microprocessor PCB Parts Locator Diagram


U2 8085A
U4 74LS138
U3 74LS373
U1 ICL 8212
Q2 2N2222A
Q3 2N2222A
Q4 2N2222A
Y1 6.000 MHz ±.005%
RP1 10K
U15A 74LS04
U15B 74LS04
U15C 74LS04
U15F 74LS04
U6A 74LS01
RESET
SELF TEST
LSWP
S1 SERVICE
NORMAL
L GPIB RESET
+5V RETURN
C10 THRU C20 .1
C21 .001
L DISABLE CMOS RAM
SELECT RAM Ø
SELECT RAM 1
ROM 4
ROM 3
ROM 2
ROM 1
ROM 0
ROM5
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
AD7
AD6
AD5
AD4
AD3
AD2
AD1
AD0
ADDRESS/DATA
WR
RD
IO/M
P9

A12 CONNECTORS	
CONNECTOR	MATES WITH
P1	A11J1
P2	A11J2
P3	A11J3
P4 PINS 1-15	A1J4
P4 PINS 16-20	A5J1 (EXT ALC GAIN)
P5	A14P5
P6	A14P6
P7	A14P7
P8	A15J2 (IND DEC LEV)

REFERENCE DESIGNATORS	
LAST USED	NOT USED
B1	U17
C22	U15E
CR6	U6C
P9	U33B & E
Q4	U32B & E
R52	
S1	
TP28	
U38	
Y1	
RP2	

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTANCES ARE IN OHMS. CAPACITANCES ARE IN MICROFARADS.
2. 2/0C MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
3. ⊘ DENOTES SCREWDRIVER ADJUST.
4. ⑨ DENOTES TEST POINTS.
5. ⏚ DENOTES +5V RETURN.
6. ▽ DENOTES ANALOG GROUND 1.

Figure 7-15. A12 Microprocessor PCB Schematic (Sheet 1 of 5)

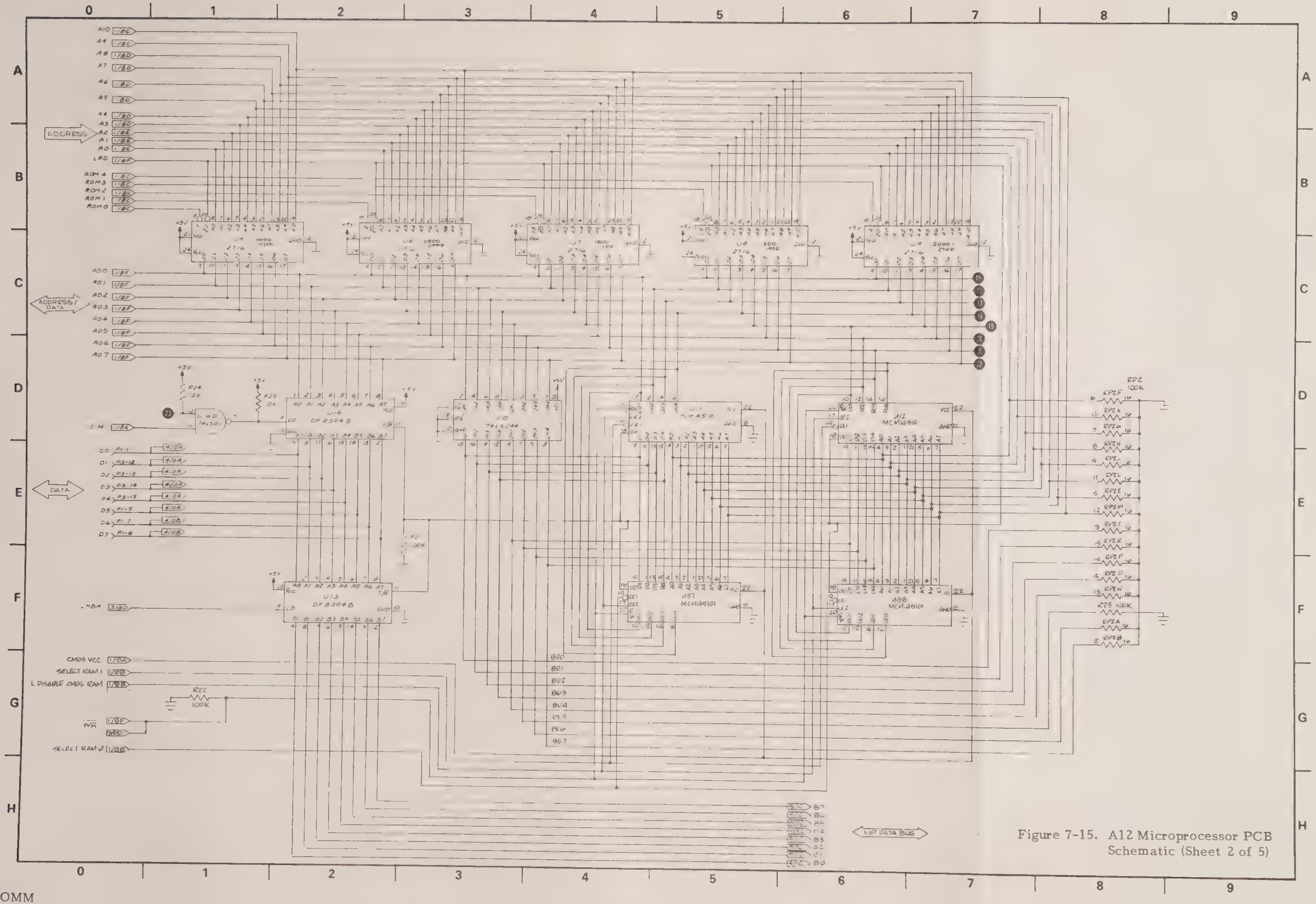

ADDRESS
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
LRD
ROM 4
ROM 3
ROM 2
ROM 1
ROM 0
ADDRESS/DATA
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
+5V
2716
U5
0000-07FF
U6
0800-0FFF
U7
1000-17FF
U8
1800-1FFF
U9
2000-27FF
R24
R25
U14
DP8304B
U13
DP8304B
U10
74LS244
U12
MCM14510
U37
MCM145101
U38
MCM145101
DATA
D0
D1
D2
D3
D4
D5
D6
D7
CMOS VCC
SELECT RAM 1
L DISABLE CMOS RAM
R22
100K
WR
SELECT RAM 0
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
RPZ
100K
R23 100K
µP DATA BUS
B7
B6
B5
B4
B3
B2
B1
B0
A
B
C
D
E
F
G
H
0
1
2
3
4
5
6
7
8
9

Figure 7-15. A12 Microprocessor PCB Schematic (Sheet 2 of 5)

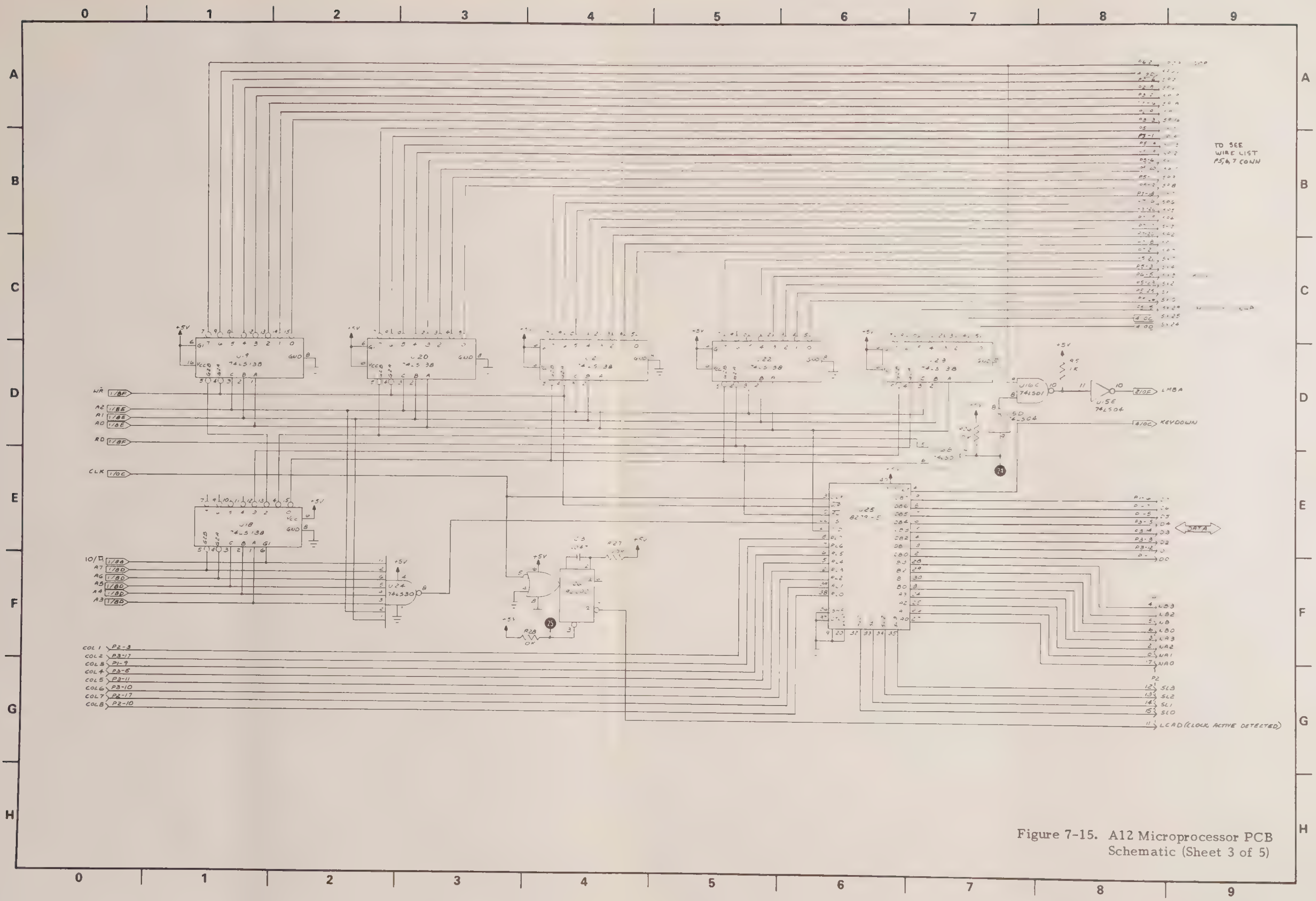

TO SEE WIRE LIST P5,6,7 CONN
U19
74LS138
U20
74LS138
U22
74LS138
U23
74LS138
U18
74LS138
U24
74LS30
U25
8279-5
U16C
74LS01
U15E
74LS04
U15D
74LS04
R5
1K
R28
+5V
GND
VCC
G1
G2A
G2B
WR
1/8F
A2
1/8E
A1
1/8E
A0
1/8E
RD
1/8F
CLK
1/0C
IO/M
1/8D
A7
A6
A5
A4
A3
COL 1 P2-3
COL 2 P3-17
COL 3 P1-9
COL 4 P3-6
COL 5 P3-11
COL 6 P3-10
COL 7 P2-17
COL 8 P2-10
2/0F LMBA
4/0C KEYDOWN
4 0C
4 0D
DB6
DB5
DB4
DB2
DB0
D5
D4
D3
D2
D0
DATA
LB3
LB2
LB0
LA3
LA2
LA1
LA0
P2
SL3
SL2
SL1
SL0
LCAD (CLOCK ACTIVE DETECTED)
24
25
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

Figure 7-15. A12 Microprocessor PCB Schematic (Sheet 3 of 5)

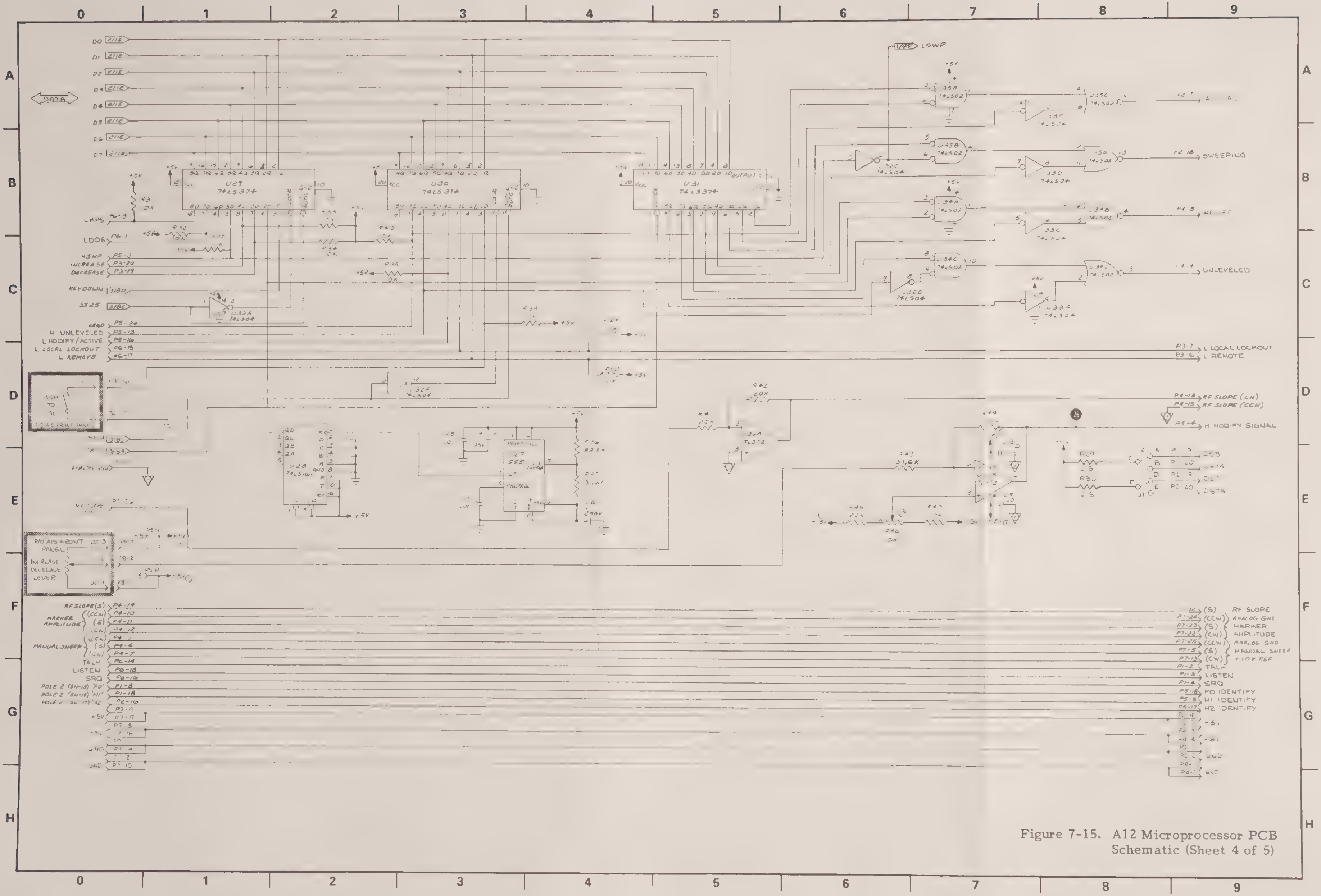

DATA
D0 D1 D2 D3 D4 D5 D6 D7
U29 74LS374
U30 74LS374
U31 74LS374
U28 74LS161
555
U32A 74LS04
LKPS
LDOS
HSWP
INCREASE
DECREASE
KEYDOWN
SX25
L MODIFY/ACTIVE
L LOCAL LOCKOUT
L REMOTE
H UNLEVELED
LSWP
SWEEPING
UNLEVELED
L LOCAL LOCKOUT
L REMOTE
RF SLOPE (CW)
RF SLOPE (CCW)
H MODIFY SIGNAL
P/O A15 FRONT PANEL
INCREASE - DECREASE LEVER
RF SLOPE(S)
MARKER AMPLITUDE
MANUAL SWEEP
TALK
LISTEN
SRQ
POLE 2 (SN-13) 'F0'
POLE 2 (SN-14) 'H1'
POLE 2 (SN-17) 'H2'
+5V
GND
RF SLOPE
ANALOG GND
MARKER AMPLITUDE
MANUAL SWEEP
+10V REF
TALK
LISTEN
SRQ
F0 IDENTIFY
H1 IDENTIFY
H2 IDENTIFY
+5V
GND
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

Figure 7-15. A12 Microprocessor PCB Schematic (Sheet 4 of 5)

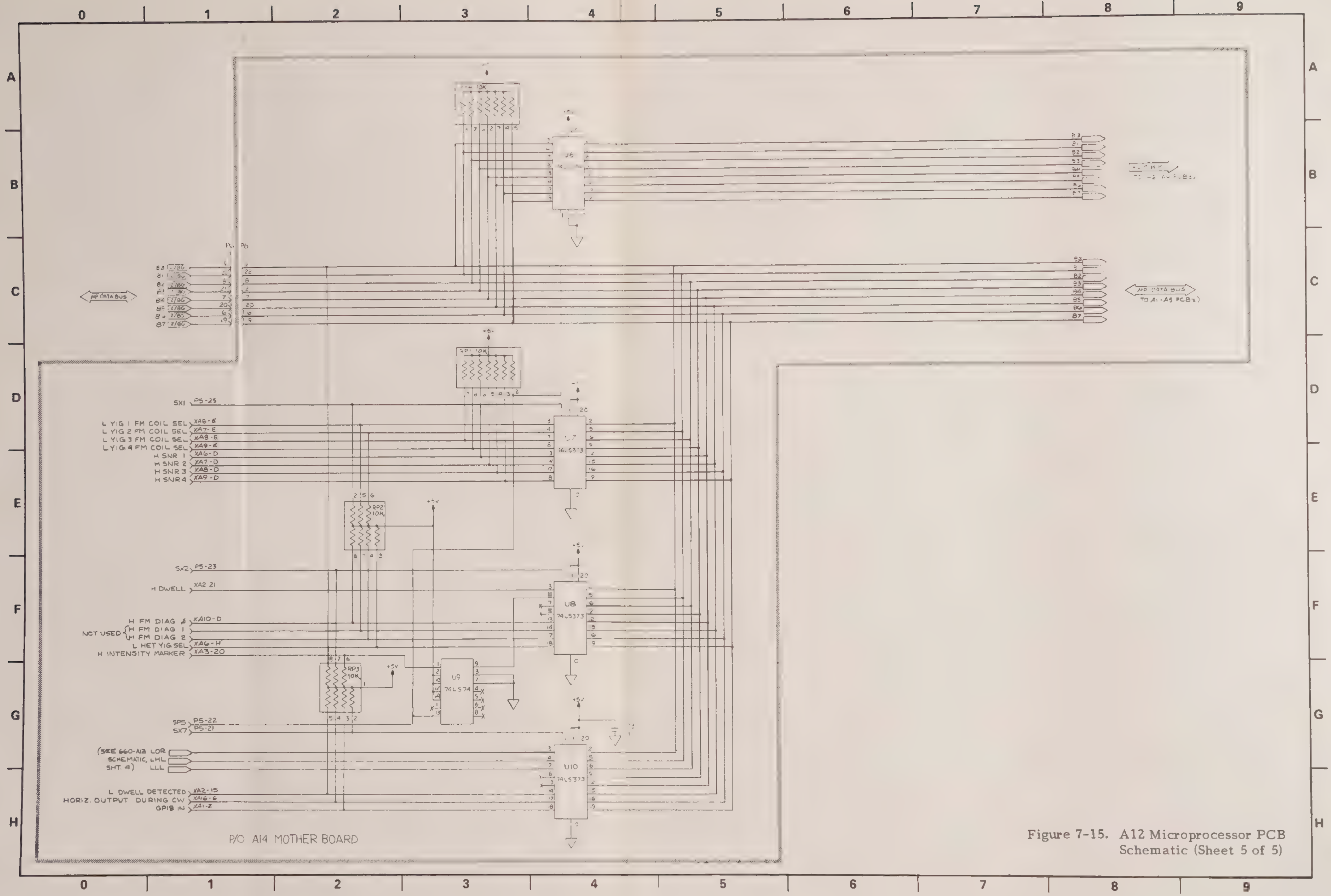

µP DATA BUS
B0
B1
B2
B3
B4
B5
B6
B7
P6
22
8
2
20
9
RP1 10K
+5V
U6
U7
74LS373
U8
74LS373
U9
74LS74
U10
74LS373
RP2 10K
RP3 10K
+5V
SX1 P5-25
L YIG 1 FM COIL SEL XA6-E
L YIG 2 FM COIL SEL XA7-E
L YIG 3 FM COIL SEL XA8-E
L YIG 4 FM COIL SEL XA9-E
H SNR 1 XA6-D
H SNR 2 XA7-D
H SNR 3 XA8-D
H SNR 4 XA9-D
SX2 P5-23
H DWELL XA2 21
H FM DIAG Ø XA10-D
NOT USED
H FM DIAG 1
H FM DIAG 2
L HET YIG SEL XA6-H
H INTENSITY MARKER XA3-20
SP5 P5-22
SX7 P5-21
(SEE 660-A12 LOR
SCHEMATIC, LHL
SHT. 4) LLL
L DWELL DETECTED XA2-15
HORIZ. OUTPUT DURING CW XA16-6
GPIB IN XA1-Z
P/O A14 MOTHER BOARD
µP DATA BUS
TO A1-A5 PCBs)
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H

Figure 7-15. A12 Microprocessor PCB Schematic (Sheet 5 of 5)

7-6.2 A12 Microprocessor PCB, Troubleshooting Information and Data

There is no error code for the A12 Microprocessor PCB. Read-only-memory (ROM) or read/write memory (RAM) malfunctions occurring in the microprocessor kernel (Figure 7-11) will cause the respective ROM's or RAM's error code to be displayed. Other malfunctions occurring within the kernel will probably result in the sweep generator's not turning on. And malfunctions occurring outside the kernel will probably result in the display of one or more analog circuit error codes. The test equipment setup for troubleshooting the A12 PCB is provided in Figure 7-16; the troubleshooting flowchart is provided in Figure 7-18.

Signature analysis is the recommended method for troubleshooting A12 circuits. In addition to a free-run mode (explained in HP Application Note 222-2), the A12 PCB also has a service mode. In this mode, routines stored in ROM U5 provide two methods for isolating to faulty components.

The first method uses a "loop-on-fail" technique (Figure 7-17) that allows the signature analyzer to quickly isolate to a malfunctioning RAM or ROM circuit. In this method the signature analyzer will display one of seven characteristic (Vcc) signatures, depending on which loop is being executed. If no errors are found, a specific signature is displayed. An error in the RAM provides a different signature. And an error in the ROM provides one of five different signatures, depending upon which chip (U5-U9) is at fault.

The second service-mode method, a routine which writes to the output ports and 8279 Keyboard/Display Interface IC, provides for signature analysis of these components. Thus, signature analysis can be used to verify whether a selected analog-PCB-mounted output port is being enabled. It can also be used to test whether the 8279 will respond to selected front panel pushbuttons. These tests are contained in Tables 7-5 and 7-6 respectively. Note that the Table 7-5 signatures are dependent on the software version contained in ROM. The software-version number (e.g. 1.7, 3.2, 4.0 etc.) momentarily appears on a front panel display at the beginning of self test. It also appears on a label affixed to ROMs U5-U9.

For free-run signature analysis, two tables of signatures are provided. Tables 7-3 and 7-4 respectively provide signatures for the microprocessor's read and write spaces. Both of these tables provide test and signature analyzer setup conditions. When these conditions are met, a characteristic (Vcc) signature will be displayed; the microprocessor circuit may then be accurately tested.

In addition to signatures, the 5004A Signature Analyzer data probe may be used like a logic probe. When a circuit node is touched, the probe tip will either flash, light steadily, or not be lit. A steadily lit probe indicates a logic 1 or Vcc. An unlit probe indicates a logic 0 or ground. And a flashing probe usually indicates pulses; however, it can also indicate noise. A noise indication sometimes occurs when the probe is touched to an open node, or when it is touched to a tri-state-buffer node where the buffer is in its off state. When testing such nodes, the 5004A will read the Vcc signature when its RESET button is pressed. To help minimize probe noise pickup, ground the probe at the same point the test pod is grounded.

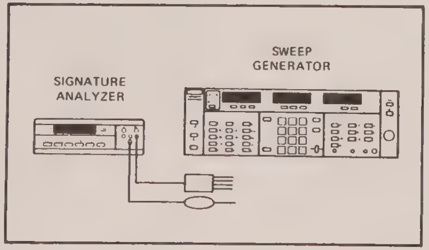


Figure 7-16. Test Setup for Troubleshooting A12 PCB

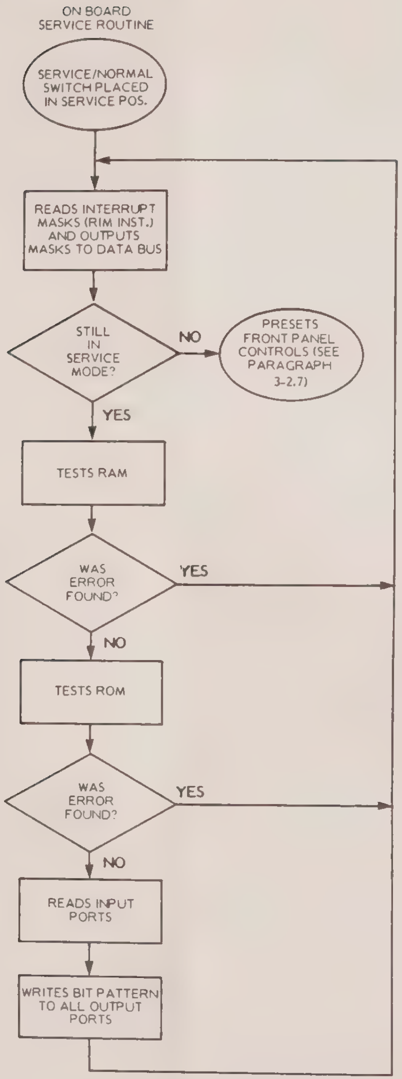

ON BOARD SERVICE ROUTINE
SERVICE/NORMAL SWITCH PLACED IN SERVICE POS.
READS INTERRUPT MASKS (RIM INST.) AND OUTPUTS MASKS TO DATA BUS
STILL IN SERVICE MODE?
NO
PRESETS FRONT PANEL CONTROLS (SEE PARAGRAPH 3-2.7)
YES
TESTS RAM
WAS ERROR FOUND?
YES
NO
TESTS ROM
WAS ERROR FOUND?
YES
NO
READS INPUT PORTS
WRITES BIT PATTERN TO ALL OUTPUT PORTS

Figure 7-17. A12 PCB On-Board Service Routine

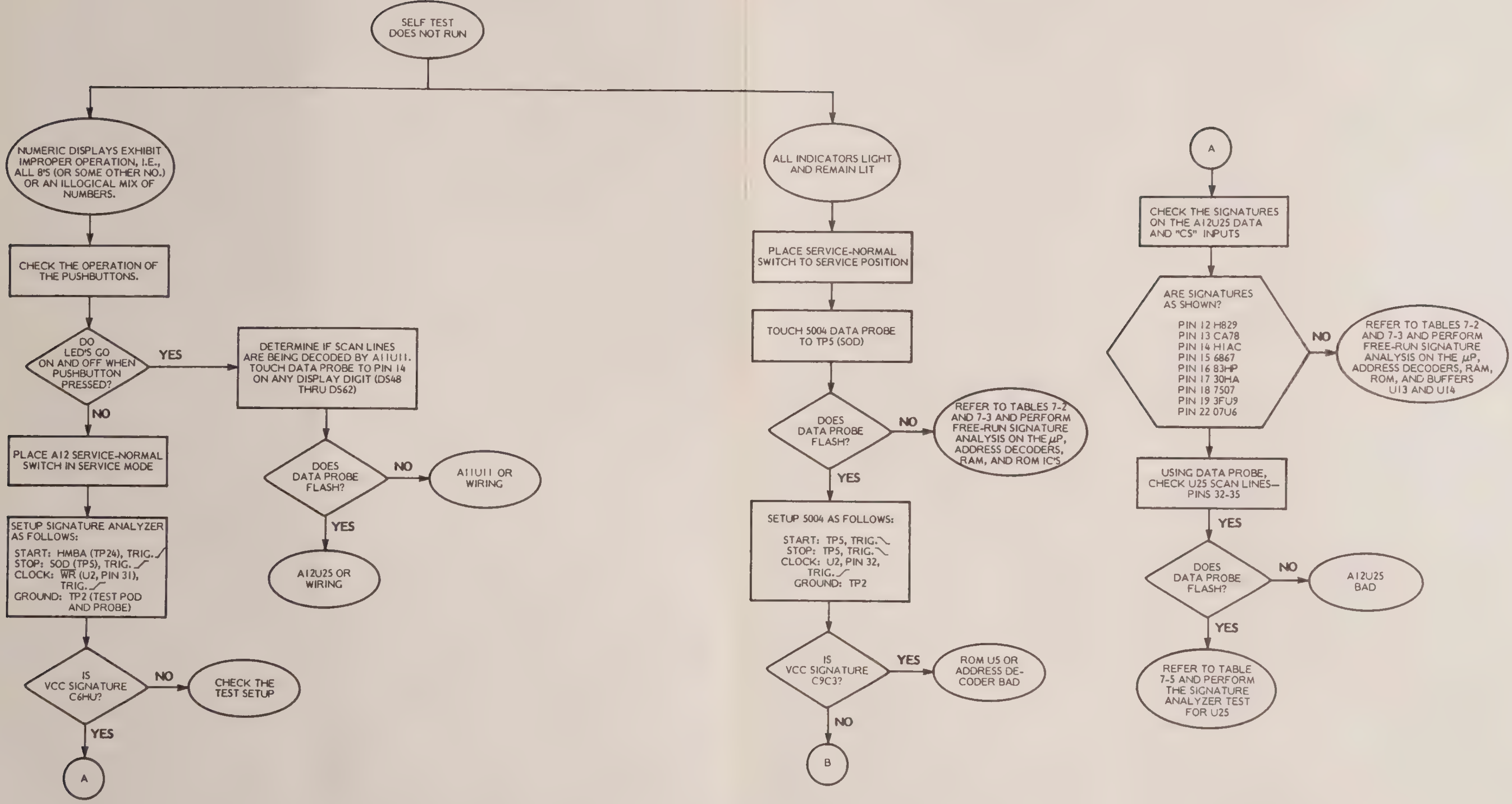

SELF TEST DOES NOT RUN
NUMERIC DISPLAYS EXHIBIT IMPROPER OPERATION, I.E., ALL 8'S (OR SOME OTHER NO.) OR AN ILLOGICAL MIX OF NUMBERS.
CHECK THE OPERATION OF THE PUSHBUTTONS.
DO LED'S GO ON AND OFF WHEN PUSHBUTTON PRESSED?
YES
DETERMINE IF SCAN LINES ARE BEING DECODED BY A11U11. TOUCH DATA PROBE TO PIN 14 ON ANY DISPLAY DIGIT (DS48 THRU DS62)
DOES DATA PROBE FLASH?
NO
A11U11 OR WIRING
YES
A12U25 OR WIRING
NO
PLACE A12 SERVICE-NORMAL SWITCH IN SERVICE MODE
SETUP SIGNATURE ANALYZER AS FOLLOWS:
START: HMBA (TP24), TRIG. ⟋
STOP: SOD (TP5), TRIG. ⟋
CLOCK: $\overline{\text{WR}}$ (U2, PIN 31), TRIG. ⟋
GROUND: TP2 (TEST POD AND PROBE)
IS VCC SIGNATURE C6HU?
NO
CHECK THE TEST SETUP
YES
A
ALL INDICATORS LIGHT AND REMAIN LIT
PLACE SERVICE-NORMAL SWITCH TO SERVICE POSITION
TOUCH 5004 DATA PROBE TO TP5 (SOD)
DOES DATA PROBE FLASH?
NO
REFER TO TABLES 7-2 AND 7-3 AND PERFORM FREE-RUN SIGNATURE ANALYSIS ON THE μP, ADDRESS DECODERS, RAM, AND ROM IC'S
YES
SETUP 5004 AS FOLLOWS:
START: TP5, TRIG. ⟍
STOP: TP5, TRIG. ⟍
CLOCK: U2, PIN 32, TRIG. ⟋
GROUND: TP2
IS VCC SIGNATURE C9C3?
YES
ROM U5 OR ADDRESS DECODER BAD
NO
B
A
CHECK THE SIGNATURES ON THE A12U25 DATA AND "CS" INPUTS
ARE SIGNATURES AS SHOWN?
PIN 12 H829
PIN 13 CA78
PIN 14 H1AC
PIN 15 6867
PIN 16 83HP
PIN 17 30HA
PIN 18 7507
PIN 19 3FU9
PIN 22 07U6
NO
REFER TO TABLES 7-2 AND 7-3 AND PERFORM FREE-RUN SIGNATURE ANALYSIS ON THE μP, ADDRESS DECODERS, RAM, ROM, AND BUFFERS U13 AND U14
USING DATA PROBE, CHECK U25 SCAN LINES—PINS 32-35
YES
DOES DATA PROBE FLASH?
NO
A12U25 BAD
YES
REFER TO TABLE 7-5 AND PERFORM THE SIGNATURE ANALYZER TEST FOR U25

Figure 7-18. A12 PCB Troubleshooting Flowchart (Sheet 1 of 2)

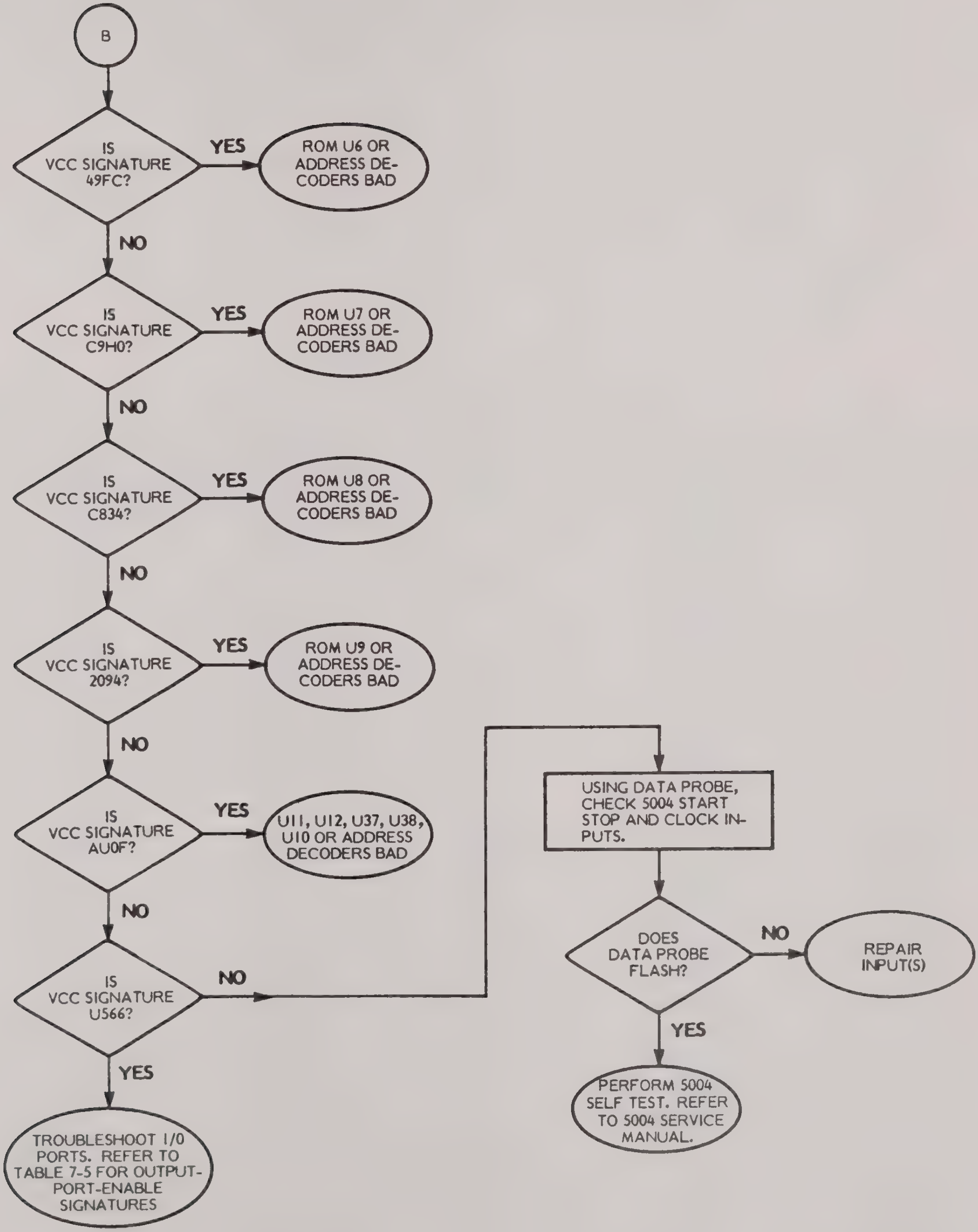

B
IS VCC SIGNATURE 49FC?
YES
ROM U6 OR ADDRESS DECODERS BAD
NO
IS VCC SIGNATURE C9H0?
YES
ROM U7 OR ADDRESS DECODERS BAD
NO
IS VCC SIGNATURE C834?
YES
ROM U8 OR ADDRESS DECODERS BAD
NO
IS VCC SIGNATURE 2094?
YES
ROM U9 OR ADDRESS DECODERS BAD
NO
IS VCC SIGNATURE AU0F?
YES
U11, U12, U37, U38, U10 OR ADDRESS DECODERS BAD
NO
IS VCC SIGNATURE U566?
NO
YES
TROUBLESHOOT I/O PORTS. REFER TO TABLE 7-5 FOR OUTPUT-PORT-ENABLE SIGNATURES
USING DATA PROBE, CHECK 5004 START STOP AND CLOCK INPUTS.
DOES DATA PROBE FLASH?
NO
REPAIR INPUT(S)
YES
PERFORM 5004 SELF TEST. REFER TO 5004 SERVICE MANUAL.

Figure 7-18. A12 PCB Troubleshooting Flowchart (Sheet 2 of 2)

Table 7-3. A12 PCB Free-run Mode Signatures – Read Space Test

GENERAL:

Test Conditions: TEST-NORMAL Switch in NORMAL.
Free-run jumper J9 removed.

Signature Analyzer Setup:

START: Bit A15 (TP7), Trigger ‾_ (Button In)

STOP: Bit A15 (TP7), Trigger _/‾ (Button Out)

CLOCK: $\overline{\text{RD}}$ (U2, Pin 32), Trigger _/‾ (Button Out)

Vcc Signature: 755U

NOTES

[1] Test probe flashes.
[2] Signature may be unstable.
[3] May have to press RESET on probe.

IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE
U1	1	755U	U2	32	0000[1]	U4	11	8UH9	U7	1	A3C1	U9	7	C113
	2	755U		33	755U		12	340A		2	7211		8	H335
	3	755U		34	0000		13	P352		3	AA08		12	0000
	4	0000		35	755U		14	U1U2		4	C4C3		18	8UH9
	5	0000		36	755U		15	4CP2		5	0772		19	HH86
	6	0000		37	755U[1]		16	755U		6	7050		20	0000
	7	0000		38	0000					7	C113		21	755U
	8	755U		39	0000	U5	1	A3C1		8	H335		22	577A
				40	755U		2	7211		12	0000		23	7707
U2	1	0000[1]					3	AA08		18	P352		24	755U
	2	755U[1]	U3	1	0000		4	C4C3		19	HH86			
	3	0000		2	H335		5	0772		20	0000[1]	U18	1	0772
	4	0000		3	755U[1]		6	7050		21	755U		2	C4C3
	5	0000		4	755U[1]		7	C113		22	577A		3	AA08
	6	0000		5	C113		8	H335		23	7707		4	7211
	7	0000		6	7050		12	0000		24	755U		5	A3C1
	8	0000		7	755U[1]		18	4CP2					6	0000
	9	0000		8	755U[1]		19	HH86	U8	1	A3C1		7	755U
	10	0000		9	0772		20	0000[1]		2	7211		8	0000
	11	755U		10	0000		21	755U		3	AA08		9	755U
	12	755U[1]		11	0000[1]		22	577A		4	C4C3		10	755U
	13	755U[1]		12	C4C3		23	7707		5	0772		11	755U
	14	755U[1]		13	755U[1]		24	755U		6	7050		12	755U
	15	755U[1]		14	755U[1]					7	C113		13	755U
	16	755U[1]		15	AA08	U6	1	A3C1		8	H335		14	755U
	17	755U[1]		16	7211		2	7211		12	0000			
	18	755U[1]		17	755U[1]		3	AA08		18	340A	U19	1	H335
	19	0000[1]		18	0000[1]		4	C4C3		19	HH86		2	C113
	20	0000		19	A3C1		5	0772		20	0000[1]		3	7050
	21	7707		20	755U		6	7050		21	755U		4	755U
	22	577A					7	C113		22	577A		5	755U
	23	HH86	U4	1	89F1		8	H335		23	7707		6	755U
	24	89F1		2	AC99		12	0000		24	755U		7	755U
	25	AC99		3	PCF3		18	U1U2					8	0000
	26	PCF3		4	1180		19	HH86	U9	1	A3C1		9	755U
	27	1180		5	0000		20	0000[1]		2	7211		10	755U
	28	0000[1]		6	755U		21	755U		3	AA08			
	29	755U		7	6F7P		22	577A		4	C4C3			
	30	0000[1]		8	0000		23	7707		5	0772			
	31	755U		9	F615		24	755U		6	7050			
				10	2F25									

Table 7-4. A12 PCB Free-run-Mode Signatures – Address Space Test (Sheet 1 of 2)

Test Conditions: SERVICE-NORMAL switch is NORMAL.
Free-run jumper J9 removed.

Signature Analyzer Setup:

START: Bit A15 (TP7), Trigger ‾_ (Button In)

STOP: Bit A15 (TP7), Trigger _/‾ (Button Out)

CLOCK: ALE (TP27), Trigger ‾_ (Button In)

GROUND: TP2 (Test Pod and Probe)

Vcc Signature: 755U

NOTES

[1] Test probe flashes.
[2] Signature may be unstable.
[3] May have to press RESET on probe.

IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE
U1	1	755U	U2	28	0000[1]	U4	1	89F1	U6	1	A3C1	U8	1	A3C1
	2	755U		29	755U		2	AC99		2	7211		2	7211
	3	755U		30	755U		3	PCF3		3	AA08		3	AA08
	4	0000		31	755U		4	1180		4	C4C3		4	C4C3
	5	0000		32	755U[1]		5	0000		5	0772		5	0772
	6	755U[3]		33	755U		6	755U		6	7050		6	7050
	7	755U		34	0000		7	6F7P		7	C113		7	C113
	8	755U		35	755U		8	0000		8	H335		8	H335
				36	755U		9	F615		12	0000		12	0000
U2	1	0000[1]		37	755U[1]		10	2F25		18	U1U2		18	340A
	2	0000[1]		38	0000		11	8UH9		19	HH86		19	HH86
	3	0000		39	0000		12	340A		20	755U[1]		20	755U[1]
	4	0000		40	755U		13	P352		21	755U		21	755U
	5	755U					14	U1U2		22	577A		22	577A
	6	755U	U3	1	0000		15	4CP2		23	7707		23	7707
	7	0000		2	H335		16	755U		24	755U		24	755U
	8	0000		3	H335									
	9	0000		4	C113	U5	1	A3C1	U7	1	A3C1	U9	1	A3C1
	10	0000		5	C113		2	7211		2	7211		2	7211
	11	755U		6	7050		3	AA08		3	AA08		3	AA08
	12	H335		7	7050		4	C4C3		4	C4C3		4	C4C3
	13	C113		8	0772		5	0772		5	0772		5	0772
	14	7050		9	0772		6	7050		6	7050		6	7050
	15	0772		10	0000		7	C113		7	C113		7	C113
	16	C4C3		11	755U[1]		8	H335		8	H335		8	H335
	17	AA08		12	C4C3		12	0000		12	0000		12	0000
	18	7211		13	C4C3		18	4CP2		18	P352		19	HH86
	19	A3C1		14	AA08		19	HH86		19	HH86		20	755U[1]
	20	0000		15	AA08		20	755U[1]		20	755U[1]		21	755U
	21	7707		16	7211		21	755U		21	755U		22	577A
	22	577A		17	7211		22	577A		22	577A		23	7707
	23	HH86		18	A3C1		23	7707		23	7707		24	755U
	24	89F1		19	A3C1		24	755U		24	755U			
	25	AC99		20	755U									
	26	PCF3												
	27	1180												

Table 7-4. A12 PCB Free-run-Mode Signatures – Address Space Test (Sheet 2 of 2)

IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE
U15	1	0000	U16	1	A3C1	U18	1	0772	U19	1	H335
	2	755U		2	755U		2	C4C3		2	C113
	3	755U		3	0000[1]		3	AA08		3	7050
	4	0000		4	0000		4	7211		4	755U
	5	755U		5	755U		5	A3C1		5	755U
	6	0000		6	755U		6	0000		6	755U
	7	0000		7	0000		7	755U		7	755U
	8	755U		8	755U		8	0000		8	0000
	9	0000		9	755U		9	755U		9	755U
	10	755U		10	0000		10	755U		10	755U
	11	0000		11	0000		11	755U			
	12	0000[1]		12	755U		12	755U			
	13	755U[1]		13	755U		13	755U			
	14	755U		14	755U		14	755U			
							15	755U			
							16	755U			

Table 7-5. A12 PCB Output-Port-Enable Lines Test

Purpose: This test checks whether the output ports, located on individual A1 thru A5 PCBs, are being enabled. The signatures are read on A14P3. Each P3 pin shows the corresponding A12 PCB IC and pin number.

Test Conditions: SERVICE-NORMAL switch in SERVICE mode. Free-run jumper J9 installed.

Signature Analyzer Setup:

START: HMBA (TP24), Trigger _/‾ (Button Out)

STOP: SOD (TP5), Trigger _/‾ (Button Out)

CLOCK: $\overline{\text{WR}}$ (U2, pin 31), Trigger _/‾ (Button Out)

GROUND: TP2 (Test Pod and Probe)

Vcc Signature: C6HU

PIN	MNE-MONIC	A12 IC & PIN	SIGNATURE	PIN	MNE-MONIC	A12 IC & PIN	SIGNATURE
1	SP13	U20-10	P946	14	SP14	U20-9	7326
2	SP11	U20-12	2U87	15	SP12	U20-11	4U4A
3	SP9	U20-14	PPFU	16	SP10	U20-13	235P
4	SP5	U21-10	4659	17	SP15	U20-7	7A80
5	SP8	U20-15	37HO	18	SP7	U21-7	A62U
6	SP6	U21-9	C9H7	19	SP4	U21-4	CPC4
7	SP3	U21-12	3069	20	SP2	U21-13	HHC2
8	SP1	U21-14	0004	21	SP0	U21-15	HC6U
9	B0	TP15	C6HU	22	B1	TP16	3227
10	B2	TP17	3227	23	B3	TP18	3227
11	B4	TP19	3227	24	B5	TP20	3227
12	B6	TP21	3227	25	B7	TP22	3227
13	GND	TP2	0000	26	+5V	TP1	C6HU

Table 7-6. Service Mode Signature Analysis of A12U25

Purpose: This table provides a means of testing the 8279 Keyboard/Display Interface IC. This IC can be tested in a limited fashion by verifying that the signatures at selected A12 data-bus test points (TP15-22) change when certain front panel pushbuttons are pressed.

Test Conditions: SERVICE-NORMAL switch in SERVICE mode.
Free-run jumper J9 installed.

Signature Analyzer Setup:

START: ROM 5 line (TP9), Trigger _/‾ (Button Out).

STOP: SOD (TP5), Trigger _/‾ (Button Out).

CLOCK: $\overline{RD}$ (U2, Pin 32), Trigger _/‾ (Button Out).

GND: A12TP2 (Test pod and probe)

Vcc Signature: 9FUF

NOTE

- The A2 Ramp Generator PCB causes unstable signatures. Remove this PCB before making a signature analysis of the 8279.
- The 555 Timer circuit (A12U27, U28) causes the the signatures on data-bus bit D1 (Figure 7-15) to be unstable. Disable U27 by grounding its threshold input, pin 6.

Procedure: When activated, each of the front panel pushbuttons causes a unique keycode to be sent over the data bus (Table 7-7). This keycode can be used to verify operation of the 8279, as follows:

1. Set up the Signature Analyzer as shown above.
2. Select a testpoint for monitoring that has a binary weight (8, 4, 2, 1) large enough to provide a stable signature (such as TP18, 19, or 20).
3. Read the signature at the testpoint and verify it is stable.
4. While monitoring this stable signature, press a pushbutton that will cause the logic state of the monitored data-bus line to change, see the test points at the bottom of Table 7-7.
5. Verify that the signature either changed or became unstable when the selected pushbutton was pressed. For example: Monitor TP20 and, after ensuring a stable signature, alternately press CW F1 and ΔF F1. The signature should be unstable during operation of the two pushbuttons.

Table 7-7. Front Panel Keycode Chart

FRONT PANEL PUSHBUTTON	Decimal	FRONT PANEL KEYCODE (Binary)							
		MS Byte				LS Byte			
		8	4	2	1	8	4	2	1
0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	1
2	2	0	0	0	0	0	0	1	0
3	3	0	0	0	0	0	0	1	1
4	4	0	0	0	0	0	1	0	0
5	5	0	0	0	0	0	1	0	1
6	6	0	0	0	0	0	1	1	0
7	7	0	0	0	0	0	1	1	1
8	8	0	0	0	0	1	0	0	0
9	9	0	0	0	0	1	0	0	1
Decimal Point (.)	10	0	0	0	0	1	0	1	0
Minus Sign (-)	11	0	0	0	0	1	0	1	1
F1	12	0	0	0	0	1	1	0	0
F0	13	0	0	0	0	1	1	0	1
M1	14	0	0	0	0	1	1	1	0
F2	15	0	0	0	0	1	1	1	1
ΔF	16	0	0	0	1	0	0	0	0
M2	17	0	0	0	1	0	0	0	1
LEVEL	18	0	0	0	1	0	0	1	0
SWEEP TIME	19	0	0	0	1	0	0	1	1
	20	0	0	0	1	0	1	0	0
	21	0	0	0	1	0	1	0	1
GHz/dBm/Sec	22	0	0	0	1	0	1	1	0
MHz/dB/mS	23	0	0	0	1	0	1	1	1
CLEAR ENTRY	24	0	0	0	1	1	0	0	0
SHIFT	25	0	0	0	1	1	0	0	1
	26	0	0	0	1	1	0	1	0
F1-F2	27	0	0	0	1	1	0	1	1
M1-M2	28	0	0	0	1	1	1	0	0
FULL	29	0	0	0	1	1	1	0	1
ΔF F0	30	0	0	0	1	1	1	1	0
ΔF F1	31	0	0	0	1	1	1	1	1
CW F1	32	0	0	1	0	0	0	0	0
CW F0	33	0	0	1	0	0	0	0	1
CW M1	34	0	0	1	0	0	0	1	0
CW F2	35	0	0	1	0	0	0	1	1
CW M2	36	0	0	1	0	0	1	0	0
INCREASE (F. Ver.)	37	0	0	1	0	0	1	0	1
DECREASE (F. Ver.)	38	0	0	1	0	0	1	1	0
OFF (F. Ver.)	39	0	0	1	0	0	1	1	1
	40	0	0	1	0	1	0	0	0
STEP SWEEP (GPIB)	41	0	0	1	0	1	0	0	1
MANUAL SWEEP	42	0	0	1	0	1	0	1	0
AUTO TRIGGER	43	0	0	1	0	1	0	1	1
LINE TRIGGER	44	0	0	1	0	1	1	0	0
EXT OR SINGLE SWEEP	45	0	0	1	0	1	1	0	1
VIDEO MARKER	46	0	0	1	0	1	1	1	0
RF MARKER	47	0	0	1	0	1	1	1	1
INTENSITY MARKER	48	0	0	1	1	0	0	0	0
INTERNAL LEVELING	49	0	0	1	1	0	0	0	1
POWER METER LEVELING	50	0	0	1	1	0	0	1	0
DETECTOR LEVELING	51	0	0	1	1	0	0	1	1
RF ON	52	0	0	1	1	0	1	0	0
RETRACE RF - ON	53	0	0	1	1	0	1	0	1
SELF TEST	54	0	0	1	1	0	1	1	0
RETURN TO LOCAL	55	0	0	1	1	0	1	1	1
FM AND PHASELOCK	56	0	0	1	1	1	0	0	0
DATA BUS TEST POINTS		TP 22	TP 21	TP 20	TP 19	TP 18	TP 17	TP 16	TP 15

7-7 A11 FRONT PANEL PCB

7-7.1 A11 Front Panel PCB, Circuit Description

The A11 Front Panel PCB is the mounting plane for the front panel pushbuttons, indicators, and numeric displays. A block diagram of the A11 PCB circuitry is shown in Figure 7-19. A parts locator diagram is provided in Figure 7-20. A diagram of the front panel, showing switch and LED numbering, is provided in Figure 7-21. And the A11 PCB schematic (2 sheets) is provided in Figure 7-22.

The A11 PCB (Figure 7-19) is functionally divided into three circuits: display, switch, and LED. The display circuitry consists of the 3-to-16 Decoder (U11), the Current Source circuit (Q1-Q15), the Numeric Display digits (DS48-DS62), and the Current Sink circuit (U8, U10). The inputs to the display circuitry are scan data via the **SL0-SL3&LCAD Bus** and display-segment data via the **NA0-NA3/NB0-NB3 Bus;** both buses are from the 8279 Keyboard/Display Interface integrated circuit (A12U25). The scan data, when decoded, causes the display digits to be scanned; the segment data causes the selected segment to be lit.

The switch circuitry is divided into two groups of switches. The main switch group consists of the 3-to-8 Decoder (U7) and the 8x8 Switch Matrix (S1-S19, S22-S25, S27-S39, S42-S56, S58). The inputs to this switch circuit are the **SL0-SL3** scan bus lines from A12U25. These lines, after being decoded, sequentially scan the 8 rows of switch-matrix switches; key status is sent back to A12U25 via the 8-bit **COL1-COL8 Bus.**

The second group of switches consists of:

- SELF TEST, which causes a microprocessor interrupt when momentarily depressed, and
- F0, M1, M2, and FREQUENCY VERNIER-INCREASE and -DECREASE, which communicate information when held depressed (paragraphs 3-2.4 and 3-2.2c respectively).

These switches have two sets of contacts – the ones shown here and another set located in the switch matrix.

The LED circuitry consists of three groups of LEDs: GPIB LEDs, LEDs that flash, and LEDs that light steadily. The GPIB LEDs are the REMOTE, LOCAL LOCKOUT, TALK, LISTEN, and SRQ indicators. The flashing LEDs are the UNLEVELED, RF OFF, SWEEPING, and EXTERNAL ALC GAIN CAL (ALC CAL) indicators. Both the GPIB and the flashing LEDs are directly controlled by lines from the A12 PCB. Except for those LEDs mentioned, all of the other front panel LEDs are non-flashing types. These non-flashing LEDs are controlled by the microprocessor via the LED Latches (U1-U6). Latches U1 thru U6 are respectively clocked by select-port lines **SP16-SP21.**

7-7.2 A11 Front Panel PCB, Troubleshooting Information

There is no error code for the A11 Front Panel PCB. Malfunctions occurring on this PCB should be observable from the front panel. Use the circuit description in paragraph 7-7.1 and the block diagram in Figure 7-19 to aid in troubleshooting the A11 PCB.

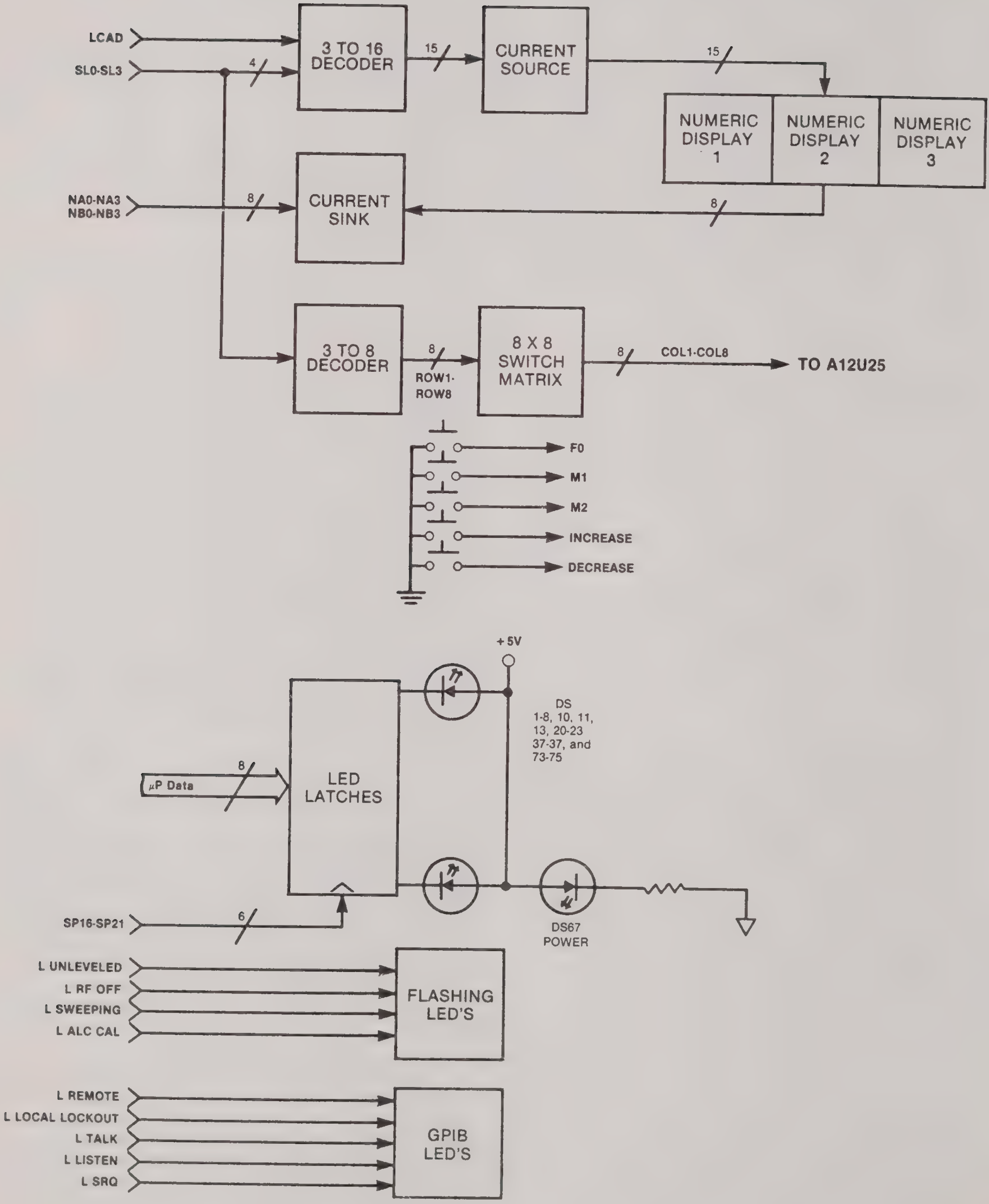
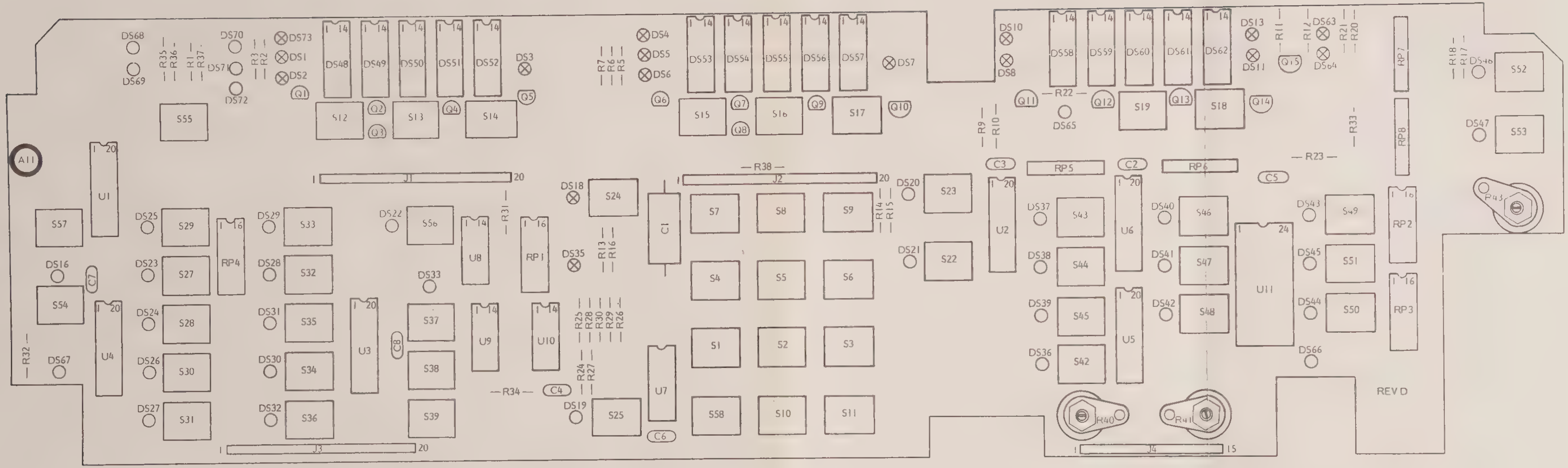

LCAD
SL0-SL3
4
3 TO 16 DECODER
15
CURRENT SOURCE
15
NUMERIC DISPLAY 1
NUMERIC DISPLAY 2
NUMERIC DISPLAY 3
NA0-NA3
NB0-NB3
8
CURRENT SINK
8
3 TO 8 DECODER
8
ROW1-ROW8
8 X 8 SWITCH MATRIX
8
COL1-COL8
TO A12U25
F0
M1
M2
INCREASE
DECREASE
+5V
DS
1-8, 10, 11,
13, 20-23
37-37, and
73-75
8
µP Data
LED LATCHES
SP16-SP21
6
DS67
POWER
L UNLEVELED
L RF OFF
L SWEEPING
L ALC CAL
FLASHING LED'S
L REMOTE
L LOCAL LOCKOUT
L TALK
L LISTEN
L SRQ
GPIB LED'S

Figure 7-19. A11 Front Panel PCB, Block Diagram


A11
DS68
DS69
R35
R36
R1
R37
DS70
DS71
DS72
R3
R2
DS73
DS1
DS2
Q1
DS48
DS49
DS50
DS51
DS52
DS3
Q2
Q3
Q4
Q5
S12
S13
S14
S55
R7
R6
R5
DS4
DS5
DS6
Q6
DS53
DS54
DS55
DS56
DS57
DS7
Q7
Q8
Q9
Q10
S15
S16
S17
DS10
DS8
R9
R10
Q11
R22
DS65
Q12
DS58
DS59
DS60
DS61
DS62
S19
Q13
S18
Q14
DS13
DS11
R11
R12
DS63
DS64
R21
R20
Q15
RP7
RP8
R18
R17
DS46
S52
DS47
S53
R33
R23
C5
R43
J1
J2
J3
J4
R38
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
RP1
RP2
RP3
RP4
RP5
RP6
C1
C2
C3
C4
C6
C7
C8
R31
R13
R16
R14
R15
R25
R28
R30
R29
R26
R24
R27
R34
R32
DS16
DS67
S57
S54
DS25
DS23
DS24
DS26
DS27
S29
S27
S28
S30
S31
DS29
DS28
DS31
DS30
DS32
S33
S32
S35
S34
S36
DS22
S56
DS33
S37
S38
S39
DS18
S24
DS35
DS19
S25
S7
S8
S9
S4
S5
S6
S1
S2
S3
S58
S10
S11
DS20
S23
DS21
S22
DS37
DS38
DS39
DS36
S43
S44
S45
S42
DS40
DS41
DS42
S46
S47
S48
DS43
DS45
DS44
DS66
S49
S51
S50
R40
R41
REV D

NOTES:

○ DENOTES YELLOW LED

⊗ DENOTES RED LED

Figue 7-20. A11 Front Panel PCB Parts Locator Diagram

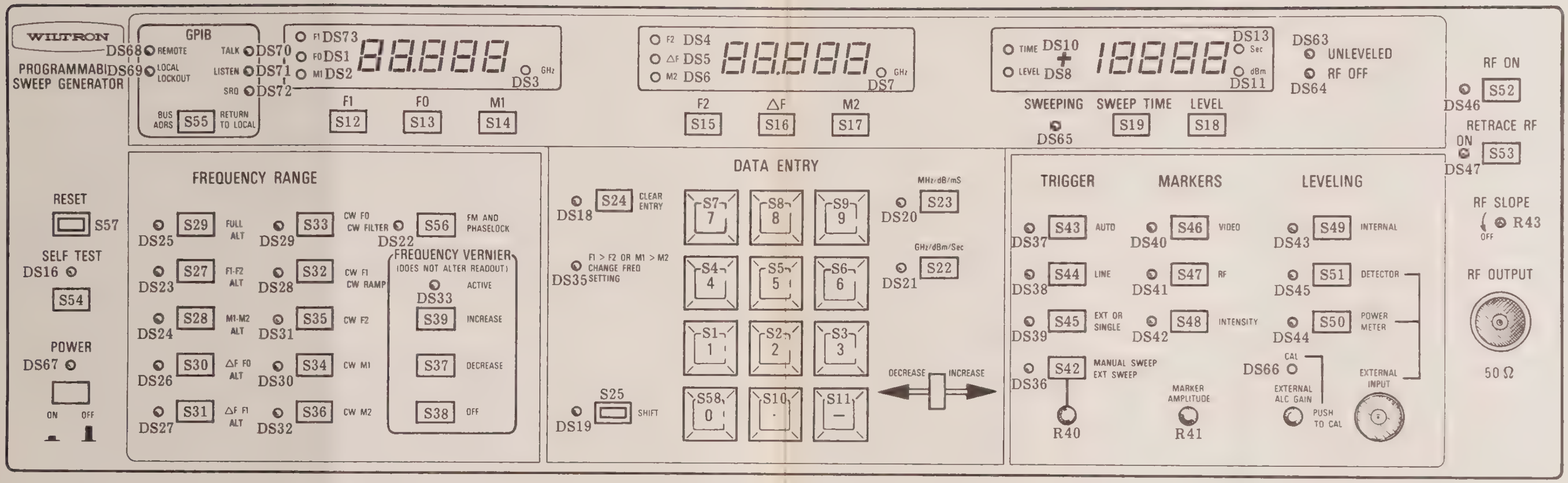
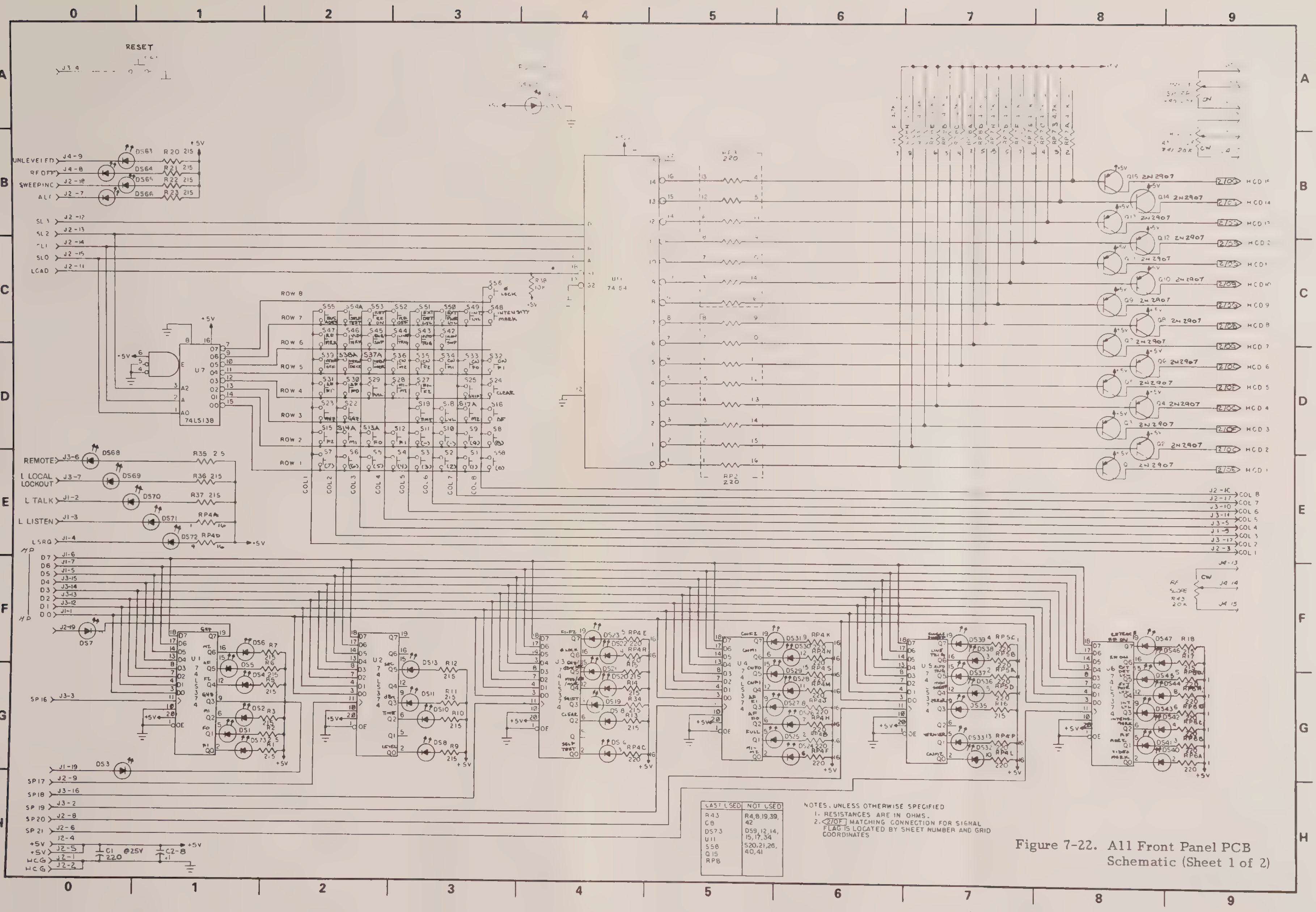

WILTRON
PROGRAMMABLE SWEEP GENERATOR
GPIB
DS68 REMOTE
DS69 LOCAL LOCKOUT
TALK DS70
LISTEN DS71
SRQ DS72
BUS ADRS S55 RETURN TO LOCAL
F1 DS73
F0 DS1
M1 DS2
GHz DS3
F1 S12
F0 S13
M1 S14
F2 DS4
ΔF DS5
M2 DS6
GHz DS7
F2 S15
ΔF S16
M2 S17
TIME DS10
LEVEL DS8
DS13 Sec
DS11 dBm
SWEEPING DS65
SWEEP TIME S19
LEVEL S18
DS63 UNLEVELED
RF OFF DS64
RF ON DS46 S52
RETRACE RF ON DS47 S53
RESET S57
SELF TEST DS16 S54
POWER DS67
ON OFF
FREQUENCY RANGE
DS25 S29 FULL ALT
DS23 S27 F1-F2 ALT
DS24 S28 M1-M2 ALT
DS26 S30 ΔF F0 ALT
DS27 S31 ΔF F1 ALT
DS29 S33 CW F0 CW FILTER
DS28 S32 CW F1 CW RAMP
DS31 S35 CW F2
DS30 S34 CW M1
DS32 S36 CW M2
DS22 S56 FM AND PHASELOCK
FREQUENCY VERNIER (DOES NOT ALTER READOUT)
DS33 ACTIVE
S39 INCREASE
S37 DECREASE
S38 OFF
DATA ENTRY
DS18 S24 CLEAR ENTRY
DS35 F1 > F2 OR M1 > M2 CHANGE FREQ SETTING
DS19 S25 SHIFT
S7 7
S8 8
S9 9
S4 4
S5 5
S6 6
S1 1
S2 2
S3 3
S58 0
S10 ·
S11 −
MHz/dB/mS DS20 S23
GHz/dBm/Sec DS21 S22
DECREASE INCREASE
TRIGGER
DS37 S43 AUTO
DS38 S44 LINE
DS39 S45 EXT OR SINGLE
DS36 S42 MANUAL SWEEP EXT SWEEP
R40
MARKERS
DS40 S46 VIDEO
DS41 S47 RF
DS42 S48 INTENSITY
MARKER AMPLITUDE R41
LEVELING
DS43 S49 INTERNAL
DS45 S51 DETECTOR
DS44 S50 POWER METER
CAL DS66
EXTERNAL ALC GAIN
PUSH TO CAL
EXTERNAL INPUT
RF SLOPE R43 OFF
RF OUTPUT
50 Ω

Figure 7-21. 6600A Series Front Panel, Showing Reference Designators for LEDs, Displays, Switches, and Controls


RESET
UNLEVELED
RF OFF
SWEEPING
ALT
SL 1
SL 2
SLO
LOAD
ROW 8
ROW 7
ROW 6
ROW 5
ROW 4
ROW 3
ROW 2
ROW 1
COL 1
COL 2
COL 3
COL 4
COL 5
COL 6
COL 7
COL 8
U7
74LS138
U11
74 54
RP2
220
REMOTE
L LOCAL LOCKOUT
L TALK
L LISTEN
LSRQ
D7
D6
D5
D4
D3
D2
D1
D0
SP 16
SP17
SP18
SP 19
SP 20
SP 21
+5V
HCG
C1 220 @25V
C2-8
DS3
DS7
U1
U2
U3
U4
U5
U6
Q15 2N2907
Q14 2N2907
Q13 2N2907
Q12 2N2907
Q11 2N2907
Q10 2N2907
Q9 2N2907
Q8 2N2907
Q7 2N2907
Q6 2N2907
Q5 2N2907
Q4 2N2907
Q3 2N2907
Q2 2N2907
Q1 2N2907
HCD 16
HCD 14
HCD 13
HCD 12
HCD 11
HCD 10
HCD 9
HCD 8
HCD 7
HCD 6
HCD 5
HCD 4
HCD 3
HCD 2
HCD 1
RF SLOPE R43 20K
CW

LAST USED	NOT USED
R43	R4,8,19,39,42
C8	DS9,12,14,15,17,34
DS73	S20,21,26,40,41
U11	
S58	
Q15	
RP8	

NOTES, UNLESS OTHERWISE SPECIFIED

1. RESISTANCES ARE IN OHMS.
2. <2/0F] MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES

Figure 7-22. A11 Front Panel PCB Schematic (Sheet 1 of 2)

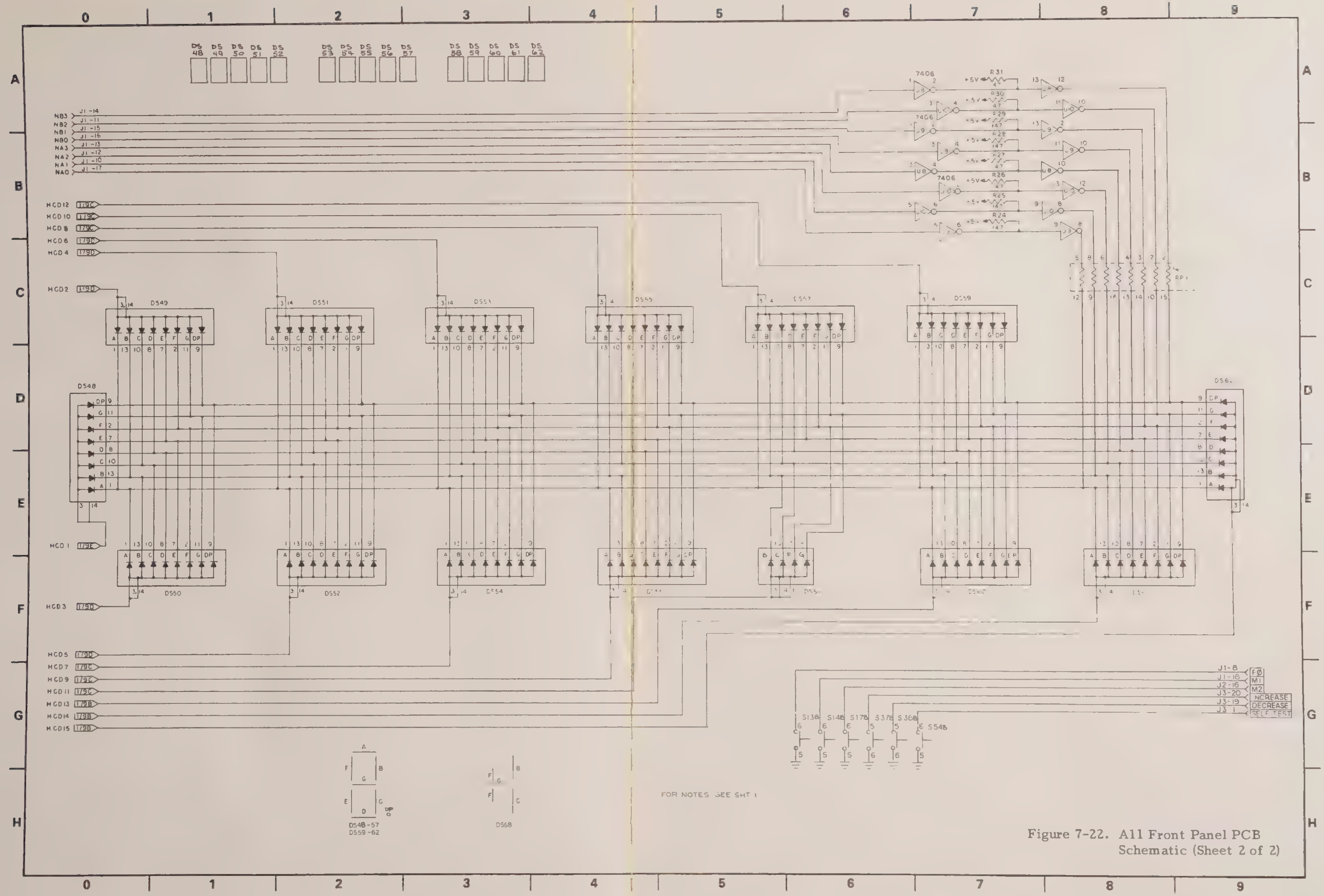

DS 48
DS 49
DS 50
DS 51
DS 52
DS 53
DS 54
DS 55
DS 56
DS 57
DS 58
DS 59
DS 60
DS 61
DS 62
NB3 J1-14
NB2 J1-11
NB1 J1-15
NB0 J1-16
NA3 J1-13
NA2 J1-12
NA1 J1-10
NA0 J1-17
7406
+5V
R31
R30
R29
R28
R27
R26
R25
R24
47
RP1
HCD12
HCD10
HCD8
HCD6
HCD4
HCD2
HCD1
HCD3
HCD5
HCD7
HCD9
HCD11
HCD13
HCD14
HCD15
DS49
DS51
DS53
DS55
DS57
DS59
DS48
DS61
DS50
DS52
DS54
DS56
DS58
DS60
DS62
A
B
C
D
E
F
G
DP
J1-8
J1-16
J2-16
J3-20
J3-19
J3-1
FØ
M1
M2
INCREASE
DECREASE
SELF TEST
S13B
S14B
S17B
S37B
S38B
S54B
FOR NOTES SEE SHT 1
DS48-57
DS59-62
DS58

Figure 7-22. A11 Front Panel PCB Schematic (Sheet 2 of 2)

7-8 A1 GPIB INTERFACE PCB

7-8.1 A1 GPIB Interface PCB, Circuit Description

The A1 PCB provides the interface between the sweep generator and the IEEE-488 GPIB. The A1 PCB is microprocessor-controlled, and contains an on-board 8085 Microprocessor IC and an 8291 GPIB Interface IC. The 8085 provides (1) control for the 8291 and other on-board circuits, and (2) communications between the A1 PCB and the A12 Microproc-essor PCB. The 8291 provides communica-tions between the sweep generator and the GPIB. Its capabilities include the following:

- Data transfer
- Handshake protocol
- Talker/listener addressing procedures
- Device clearing and triggering
- Service request (SRQ) control
- Serial and parallel-poll servicing

A functional block diagram of the A1 PCB is shown in Figure 7-23, the power-up operational program flowchart is shown in Figure 7-24, and the schematic (3 sheets) is contained in Figure 7-25.

As shown in Figure 7-23, the A1 PCB is composed of the following major circuits:

a. 6600 Analog Interface Circuits. These circuits provide the interface between the analog circuits in the sweep generator that can cause an SRQ (service request) and the GPIB microprocessor. The Analog Interface circuits are composed of the following ICs: U10C, U23A, U23B, U25D, U10A, U25A, U25B, U25C, U20B, U20A, U10D, and U16 (Figure 7-25, Sheet 2).

b. GPIB Address Switches Input Port. This circuit is the A1 PCB microprocessor input port for the rear panel GPIB address and data delimiter (CR/CR-LF) switches. The circuit is composed of U15 and its associated resistors (Figure 7-25, Sheet 2).

c. LED Drivers. These circuits drive the REMOTE, LOCAL LOCKOUT, TALK, LISTEN, and SRQ front panel GPIB LED indicators. The circuits are composed of the following components: Q1, U11D, U14A, U14B (Figure 7-25, Sheet 2), U13A, and U13B (Figure 7-25, Sheet 1).

d. 6600 µP Interface. These circuits provide interface between the A1 PCB circuits and the A12 Microprocessor PCB. The circuits are composed of the following ICs: U21A, U21B, U22, and U24 (Figure 7-25, Sheet 2).

e. ROM 2716. The ROM (read-only memory) contains the A1 PCB operational program that is flowcharted in Figure 7-24. Read-only memory consists of U4 and U5 (Figure 7-25, Sheet 1).

f. RAM 2111. The RAM (random-access memory) is the "scratchpad memory" for temporarily storing the received GPIB commands. Random-access memory consists of U2 and U3 (Figure 7-25, Sheet 1).

g. Free-Run Circuit. This circuit consists of the 18-pin jumper DIP socket U9 and its associated gates and resistors. Socket U9 is used for testing purposes – the removal of U9 causes a no-operation ("NOP") instruction to be forced into the microprocessor, causing it to free-run.

h. Address Decoder. This circuit decodes the microprocessor address bus. The outputs from this circuit are (1) active-low CE (chip enable) lines for the RAM, ROM, 8255, and 8291 ICs and (2) enable inputs for the U13A and U13B TALK and LISTEN indicator drivers.

i. Option Interface 8255. This circuit, consisting of the 8255 Microprocessor Interface IC (U1), is used with the Option 14 AUX I/O DATA connector.

j. Microprocessor 8085 and GPIB Interface IC 8291. These two circuits are described in the opening paragraph under the A1 PCB Circuit Description heading.

k. SERVICE-NORMAL Switch (S1). In the SERVICE position, S1 interrupts the microprocessor and causes it to run a stimulus routine for signature-analysis testing.

When the front panel POWER switch is depressed and ac power is turned on, the A1 PCB goes into the flowcharted routine of Figure 7-24. The A1 PCB remains in this looping routine until the ac power is turned off.

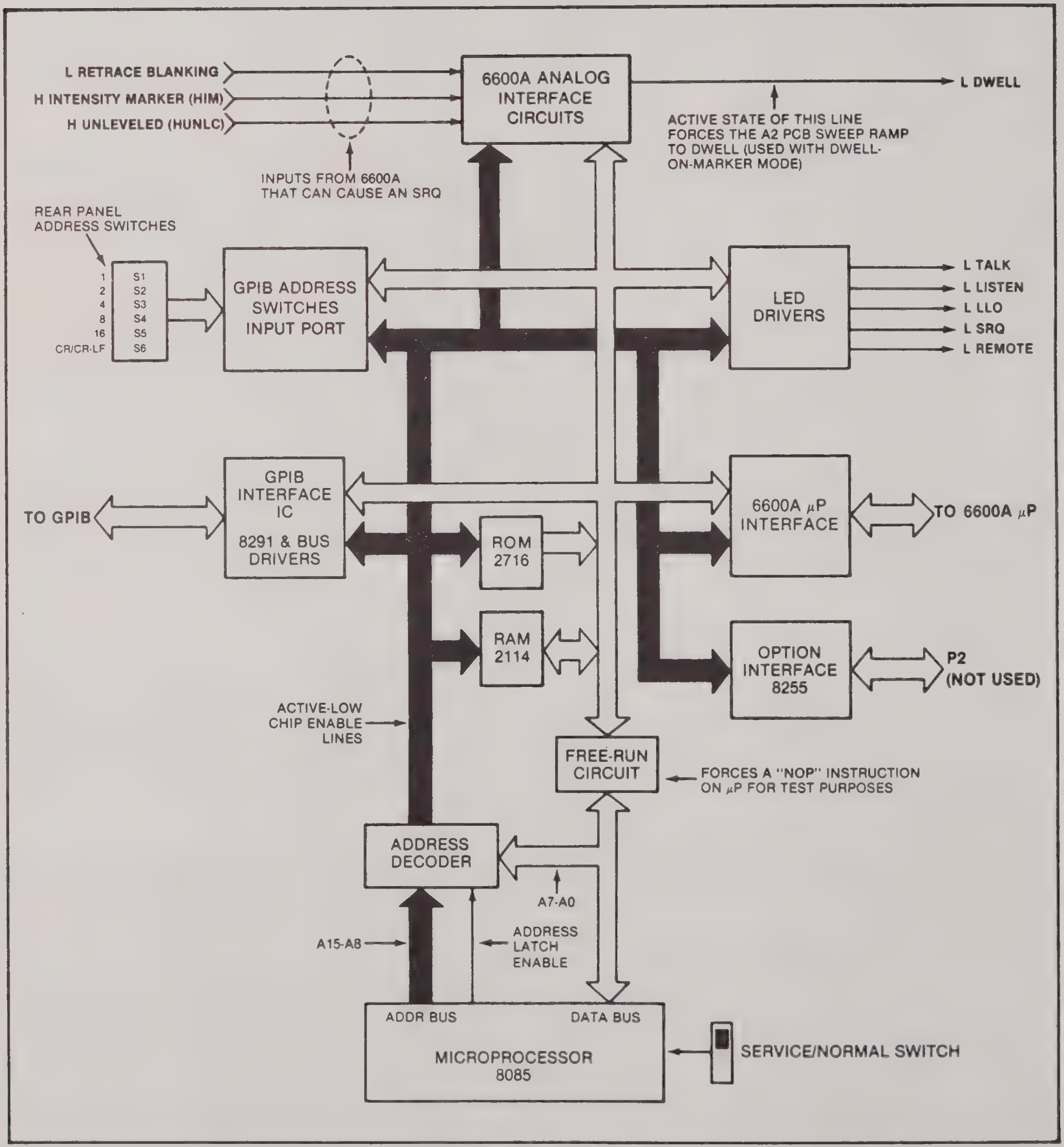

L RETRACE BLANKING
H INTENSITY MARKER (HIM)
H UNLEVELED (HUNLC)
6600A ANALOG INTERFACE CIRCUITS
L DWELL
ACTIVE STATE OF THIS LINE FORCES THE A2 PCB SWEEP RAMP TO DWELL (USED WITH DWELL-ON-MARKER MODE)
INPUTS FROM 6600A THAT CAN CAUSE AN SRQ
REAR PANEL ADDRESS SWITCHES
1 S1
2 S2
4 S3
8 S4
16 S5
CR/CR-LF S6
GPIB ADDRESS SWITCHES INPUT PORT
LED DRIVERS
L TALK
L LISTEN
L LLO
L SRQ
L REMOTE
TO GPIB
GPIB INTERFACE IC
8291 & BUS DRIVERS
ROM 2716
RAM 2114
6600A μP INTERFACE
TO 6600A μP
OPTION INTERFACE 8255
P2 (NOT USED)
ACTIVE-LOW CHIP ENABLE LINES
FREE-RUN CIRCUIT
FORCES A "NOP" INSTRUCTION ON μP FOR TEST PURPOSES
ADDRESS DECODER
A7-A0
A15-A8
ADDRESS LATCH ENABLE
ADDR BUS
DATA BUS
MICROPROCESSOR 8085
SERVICE/NORMAL SWITCH

Figure 7-23. A1 GPIB Interface PCB, Overall Block Diagram

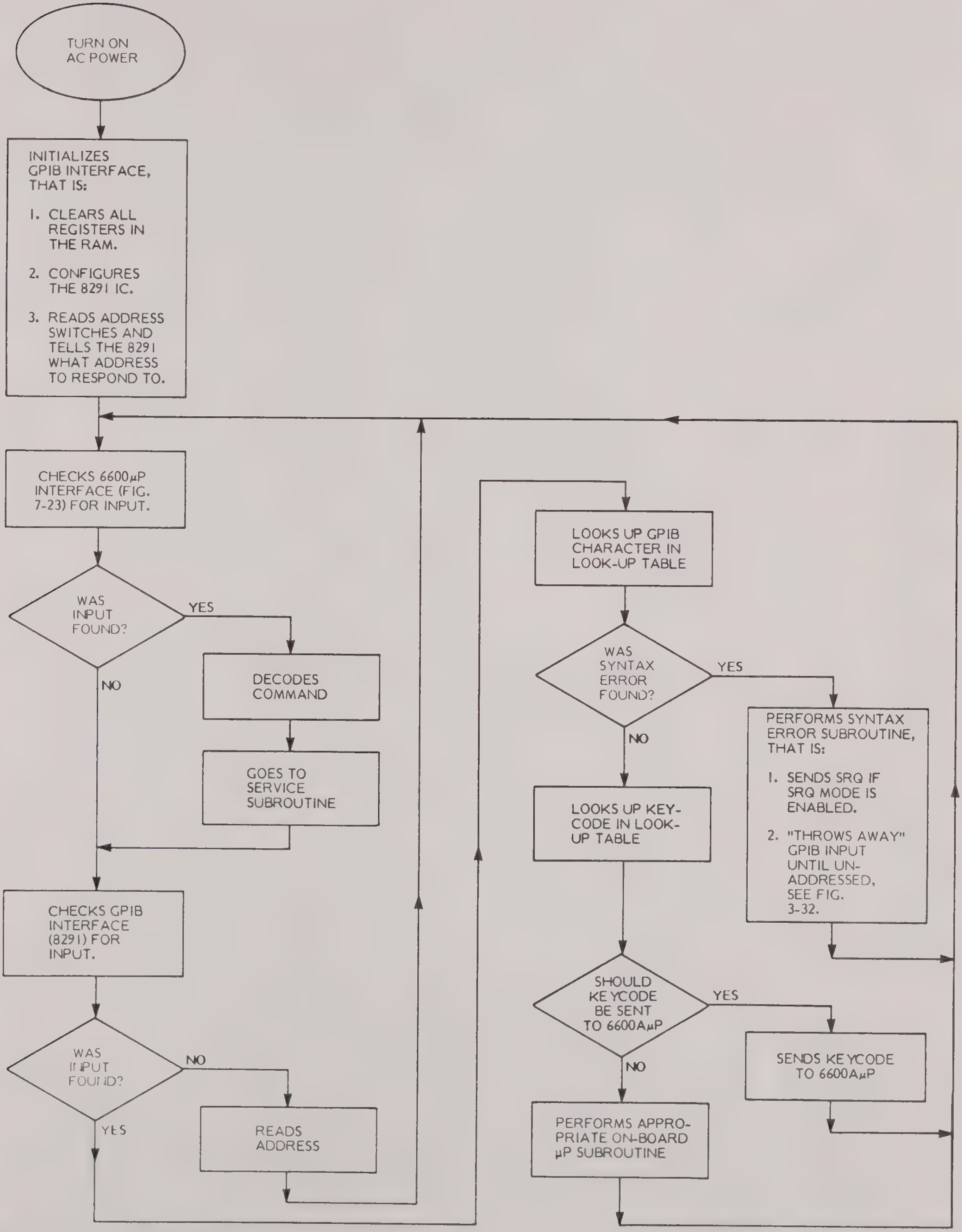
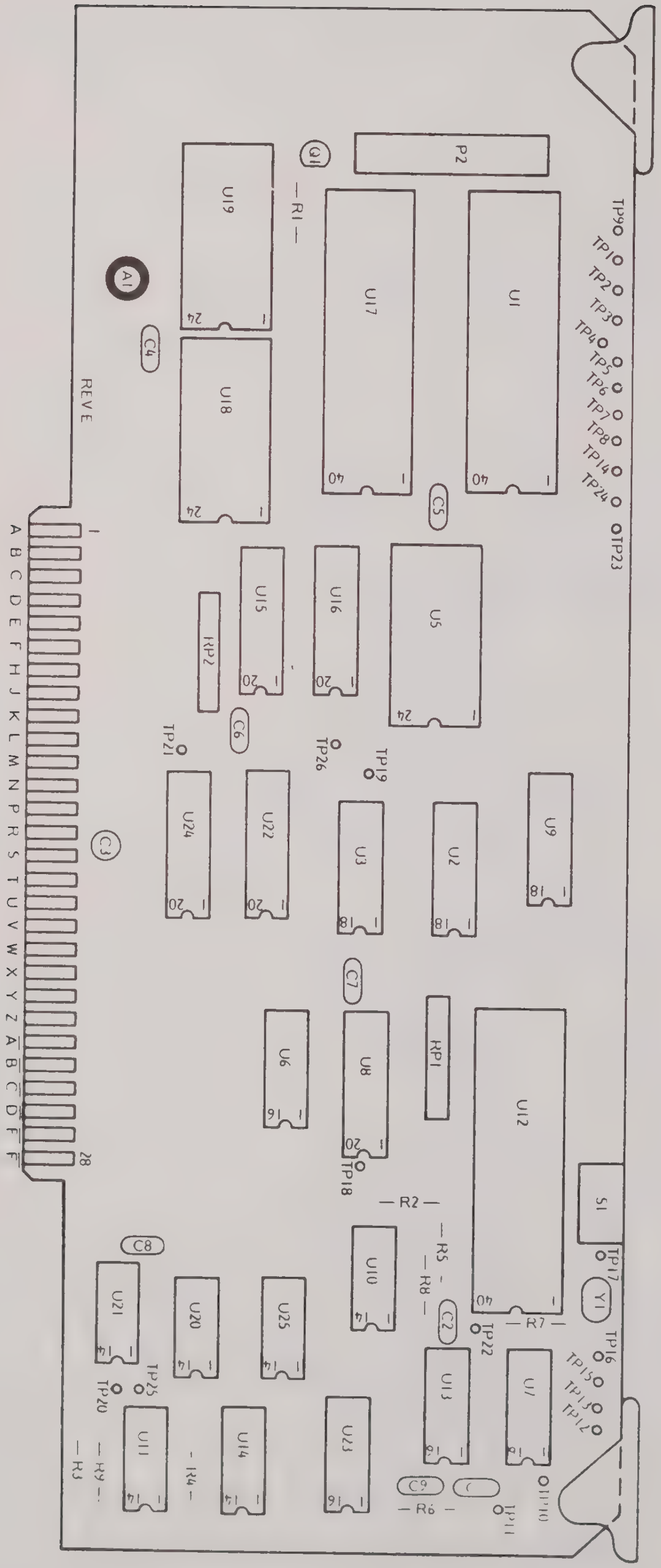
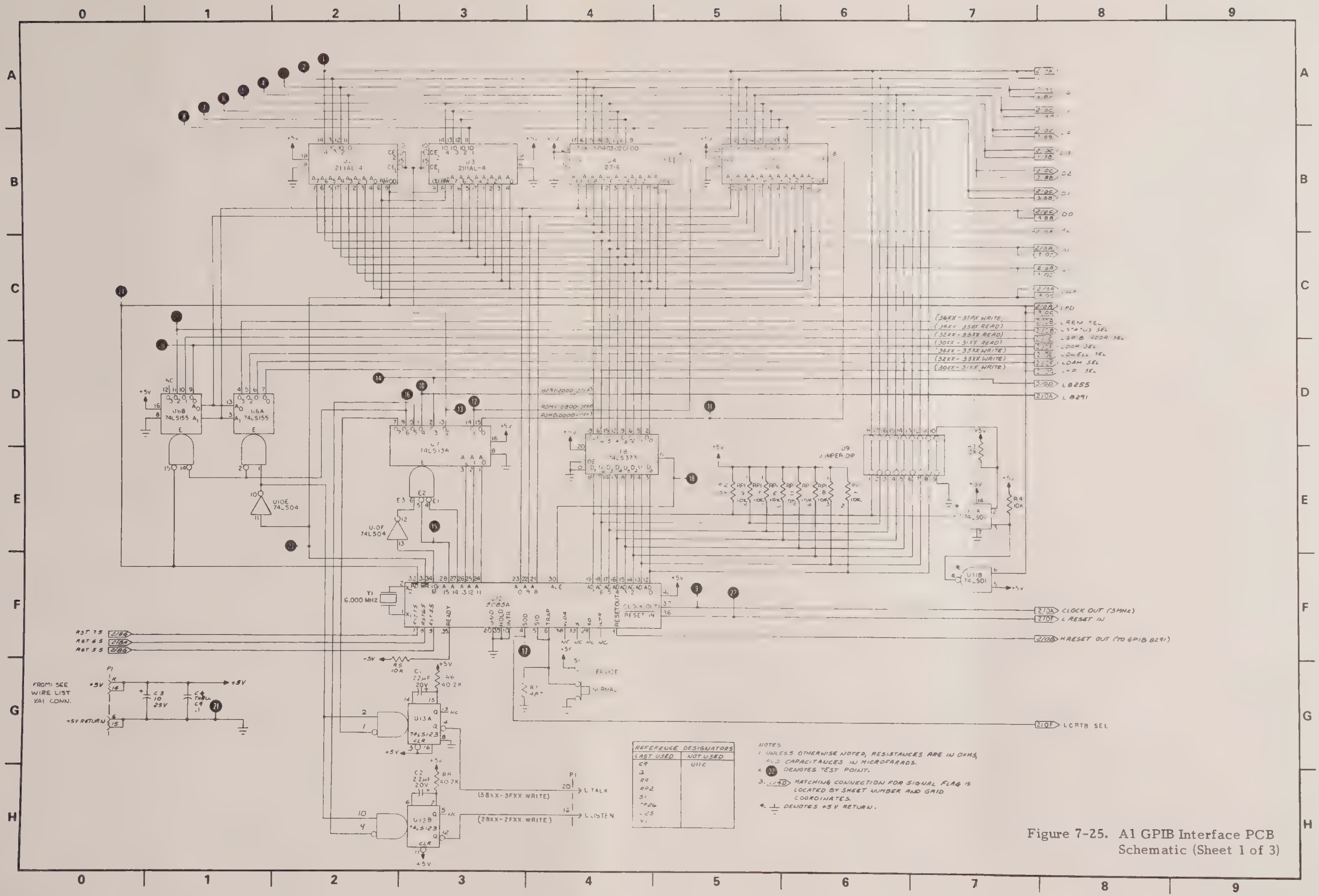

TURN ON AC POWER
INITIALIZES GPIB INTERFACE, THAT IS:
1. CLEARS ALL REGISTERS IN THE RAM.
2. CONFIGURES THE 8291 IC.
3. READS ADDRESS SWITCHES AND TELLS THE 8291 WHAT ADDRESS TO RESPOND TO.
CHECKS 6600μP INTERFACE (FIG. 7-23) FOR INPUT.
WAS INPUT FOUND?
YES
NO
DECODES COMMAND
GOES TO SERVICE SUBROUTINE
CHECKS GPIB INTERFACE (8291) FOR INPUT.
WAS INPUT FOUND?
NO
YES
READS ADDRESS
LOOKS UP GPIB CHARACTER IN LOOK-UP TABLE
WAS SYNTAX ERROR FOUND?
YES
NO
PERFORMS SYNTAX ERROR SUBROUTINE, THAT IS:
1. SENDS SRQ IF SRQ MODE IS ENABLED.
2. "THROWS AWAY" GPIB INPUT UNTIL UN-ADDRESSED, SEE FIG. 3-32.
LOOKS UP KEY-CODE IN LOOK-UP TABLE
SHOULD KEYCODE BE SENT TO 6600AμP
YES
NO
SENDS KEYCODE TO 6600AμP
PERFORMS APPROPRIATE ON-BOARD μP SUBROUTINE

Figure 7-24. A1 PCB, AC Power-On Operational Flowchart


P2
Q1
U19
R1
A1
U17
U1
TP9
TP10
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP14
TP24
TP23
C4
REV E
U18
C5
U15
U16
U5
RP2
C6
TP21
TP26
TP19
U24
U22
U3
U2
U9
C3
C7
U6
U8
RP1
U12
S1
TP18
R2
R5
R8
C8
U21
U20
U25
U10
C2
TP22
R7
Y1
TP17
TP16
TP15
TP13
TP12
U13
U7
TP25
TP20
U11
U14
U23
R4
R9
R3
C9
R6
TP11
1
28
A B C D E F H J K L M N P R S T U V W X Y Z A̅ B̅ C̅ D̅ E̅ F̅

A1 GPIB Interface PCB Parts Locator Diagram


U1
2111AL-4
U3
2111AL-4
U4
2716
U6
U8B
74LS155
U6A
74LS155
U7
74LS138
E2
U10E
74LS04
U10F
74LS04
U8
74LS373
U9
JUMPER DIP
U12
8085A
Y1
6.000 MHZ
U13A
74LS123
U13B
74LS123
U11A
74LS01
U11B
74LS01
RP1
10K
R4
10K
R5
10K
R6
40.2K
R8
40.2K
C1
22μF
20V
C2
22μF
20V
C3
10
25V
C4
THRU
C9
.1
S1
FRONT
NORMAL
P1
FROM: SEE
WIRE LIST
XA1 CONN.
+5V
+5V RETURN
RST 7.5
RST 6.5
RST 5.5
CLOCK OUT
RESET IN
READY
HOLD
INTR
TRAP
SOD
SID
RESET OUT
8291:2000
ROM1 0800
ROM0 0000
D2
D1
D0
L PD
(36XX - 37XX WRITE)
(34XX - 35XX READ)
(32XX - 33XX READ)
(30XX - 31XX READ)
(34XX - 35XX WRITE)
(32XX - 33XX WRITE)
(30XX - 31XX WRITE)
L REM SEL
L STATUS SEL
L GP B ADDR SEL
L DOR SEL
L DWELL SEL
L DAM SEL
L KP SEL
3/0D
L 8255
2/0A
L 8291
2/0A
CLOCK OUT (3MHz)
2/0F
L RESET IN
2/0B
H RESET OUT (TO GPIB 8291)
2/0F
L CRTB SEL
(38XX-3FXX WRITE)
L TALK
(28XX-2FXX WRITE)
L LISTEN
A
B
C
D
E
F
G
H
0
1
2
3
4
5
6
7
8
9

REFERENCE DESIGNATORS	
LAST USED	NOT USED
C9	U11C
J2	
R9	
RP2	
S1	
TP26	
U25	
Y1	

NOTES

1. UNLESS OTHERWISE NOTED, RESISTANCES ARE IN OHMS, AND CAPACITANCES IN MICROFARADS.
2. ㉒ DENOTES TEST POINT.
3. 1/4D MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
4. ⏚ DENOTES +5V RETURN.

Figure 7-25. A1 GPIB Interface PCB Schematic (Sheet 1 of 3)

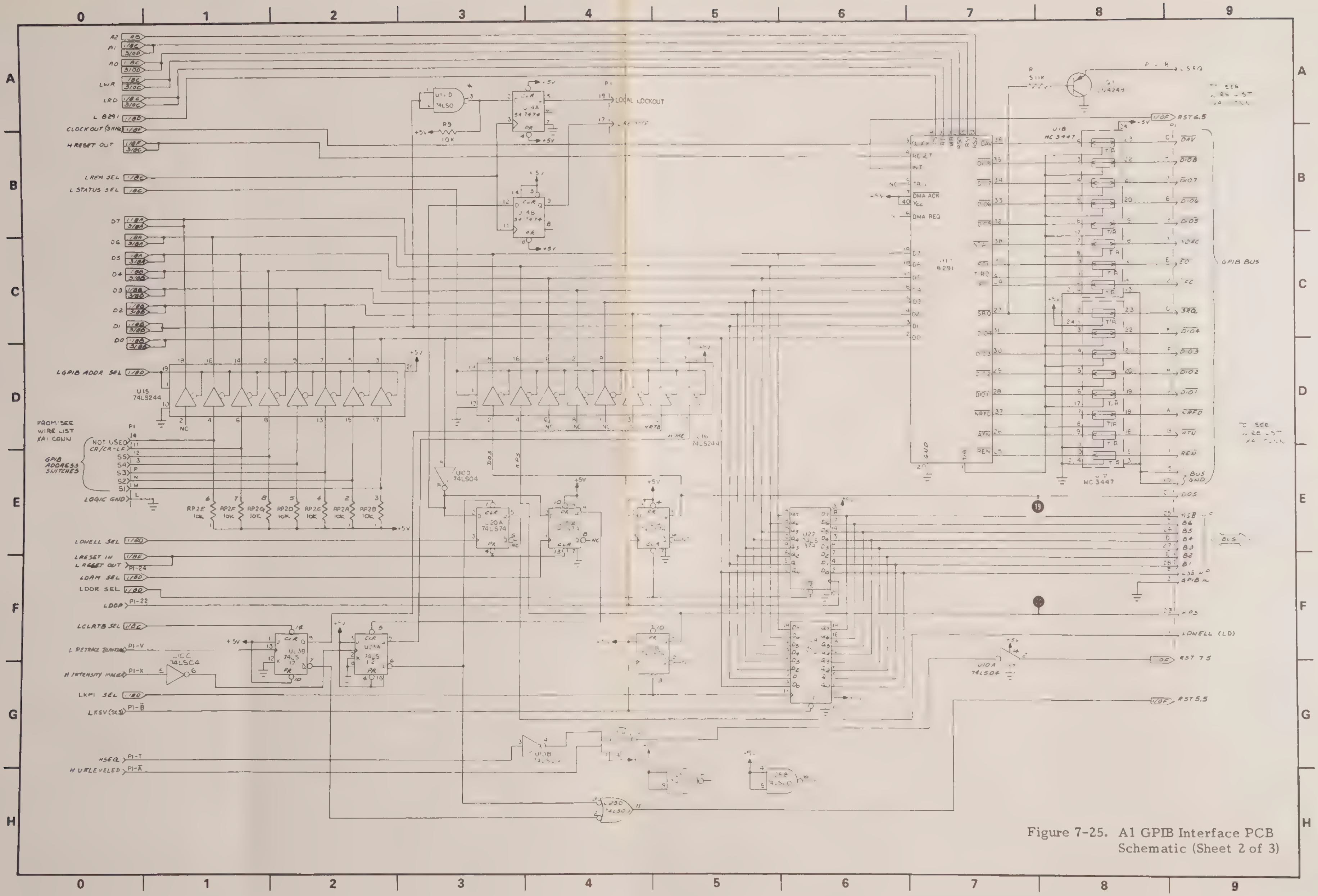
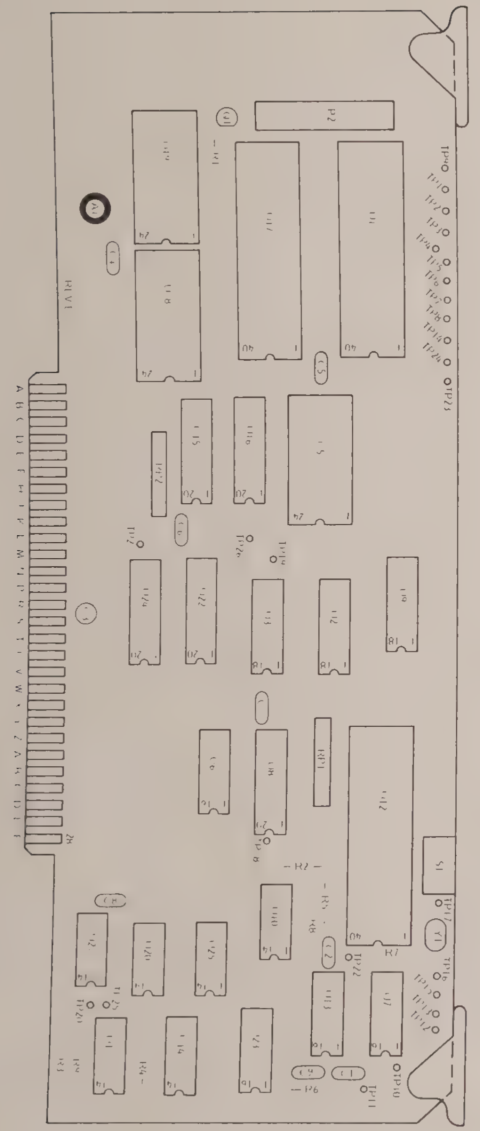

A2
A1
A0
LWR
LRD
L 8291
CLOCK OUT (3MHz)
H RESET OUT
LREM SEL
L STATUS SEL
D7
D6
D5
D4
D3
D2
D1
D0
LGPIB ADDR SEL
U15
74LS244
FROM: SEE WIRE LIST XA1 CONN
NOT USED
CR/CR-LF
S5
S4
S3
S2
S1
GPIB ADDRESS SWITCHES
LOGIC GND
RP2E
RP2F
RP2G
RP2D
RP2C
RP2A
RP2B
10K
LDWELL SEL
LRESET IN
LRESET OUT
LDAM SEL
LDOR SEL
LDOP
LCLRTB SEL
L RETRACE BLANKING
H INTENSITY MACRO
LKPI SEL
LKSV
HSEQ
H UNLEVELED
U1D
74LS0
R9
10K
+5V
LOCAL LOCKOUT
U20A
74LS74
U13B
74LS112
U13A
74LS112
U10D
74LS04
U10A
74LS04
U10B
74LS04
74LS244
NRTB
DOS
RPS
U22
U25
74LS00
8291
RESET
INT
DMA ACK
DMA REQ
DAV
NRFD
ATN
REN
SRQ
GND
U18
MC3447
T/R
Q1
2N4249
GPIB BUS
DAV
DIO8
DIO7
DIO6
DIO5
NDAC
EOI
IFC
SRQ
DIO4
DIO3
DIO2
DIO1
NRFD
ATN
REN
BUS GND
DOS
MSB
B6
B5
B4
B3
B2
B1
GPIB IN
RPS
LDWELL (LD)
RST 7.5
RST 6.5
RST 5.5
19
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H

Figure 7-25. A1 GPIB Interface PCB Schematic (Sheet 2 of 3)


A1 PCB Parts Locator Diagram

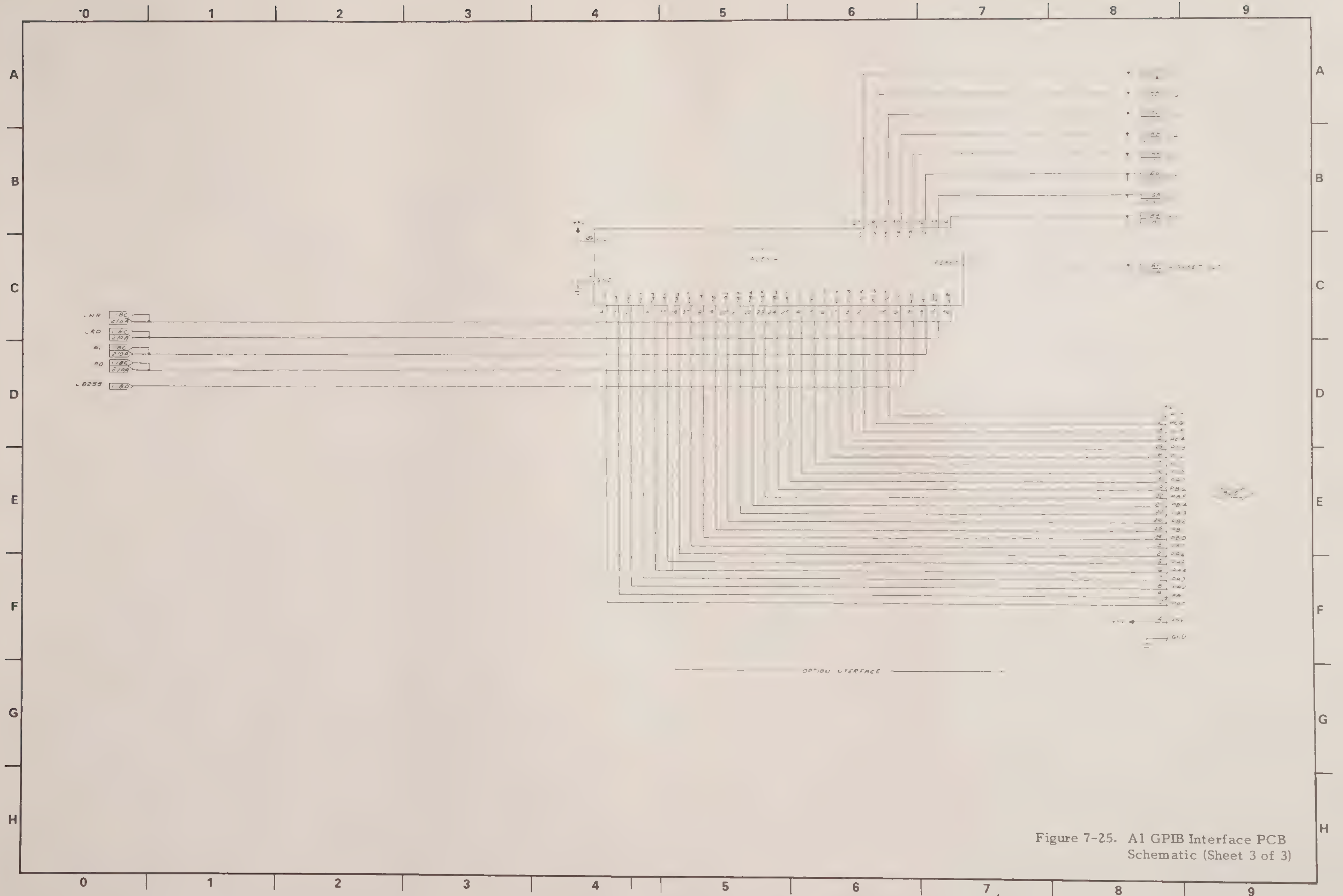

LWR
1/8C
2/10A
LRD
1/8C
2/10A
A1
8C
2/10A
A0
1/8C
2/10A
L8255
1/8D
OPTION INTERFACE
GND

Figure 7-25. A1 GPIB Interface PCB Schematic (Sheet 3 of 3)

parts locator

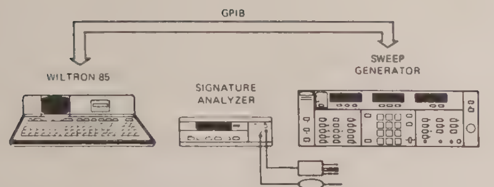

GPIB
WILTRON 85
SIGNATURE ANALYZER
SWEEP GENERATOR

Figure 7-26. Test Equipment Setup for Troubleshooting Error Code 24

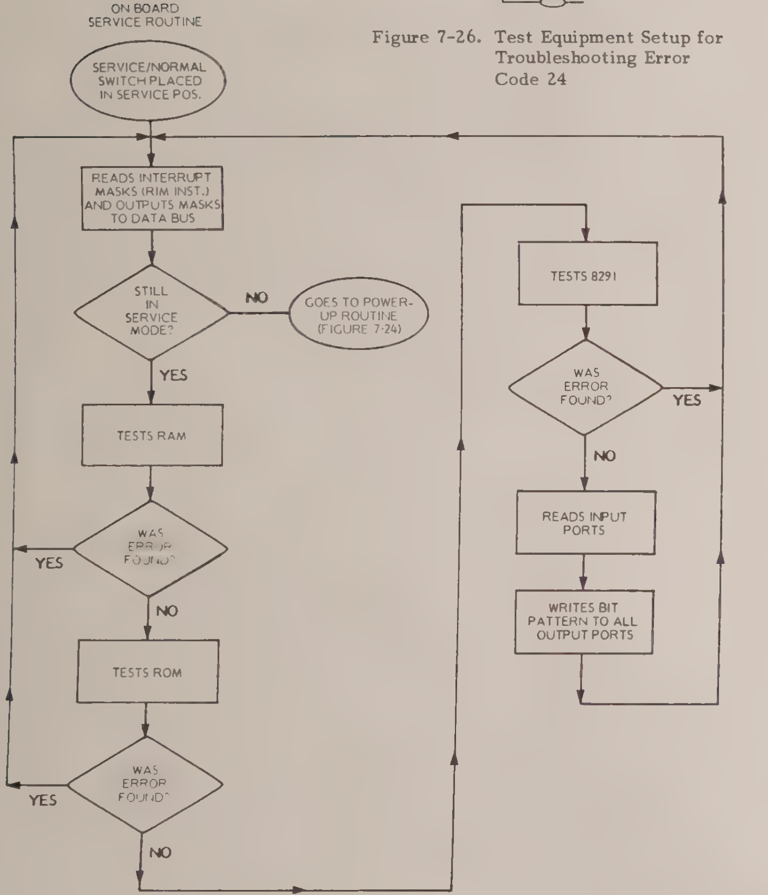

ON BOARD SERVICE ROUTINE
SERVICE/NORMAL SWITCH PLACED IN SERVICE POS.
READS INTERRUPT MASKS (RIM INST.) AND OUTPUTS MASKS TO DATA BUS
STILL IN SERVICE MODE?
NO
GOES TO POWER-UP ROUTINE (FIGURE 7-24)
YES
TESTS RAM
WAS ERROR FOUND?
YES
NO
TESTS ROM
WAS ERROR FOUND?
YES
NO
TESTS 8291
WAS ERROR FOUND?
YES
NO
READS INPUT PORTS
WRITES BIT PATTERN TO ALL OUTPUT PORTS

Figure 7-27. A1 PCB On-Board Service Routine

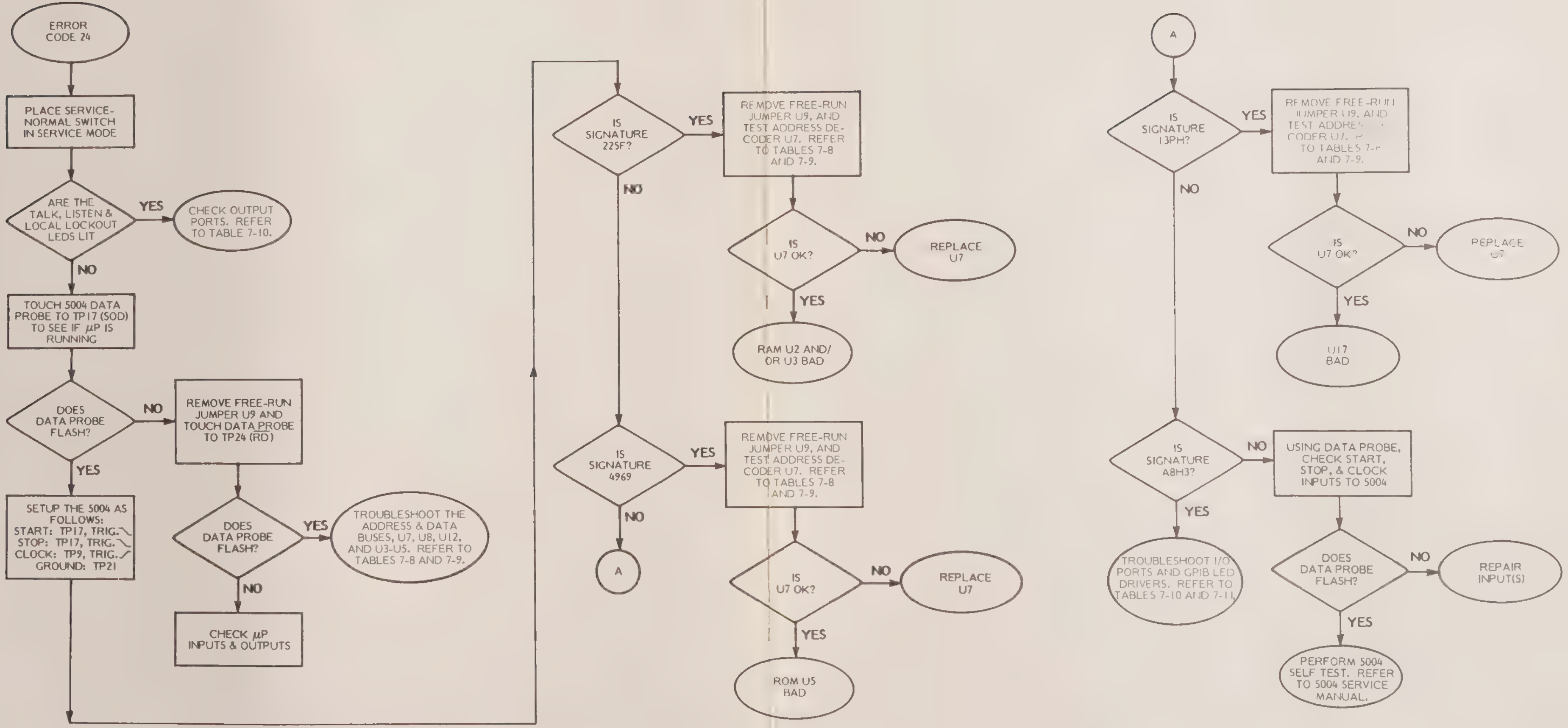

ERROR CODE 24
PLACE SERVICE-NORMAL SWITCH IN SERVICE MODE
ARE THE TALK, LISTEN & LOCAL LOCKOUT LEDS LIT
YES
CHECK OUTPUT PORTS. REFER TO TABLE 7-10.
NO
TOUCH 5004 DATA PROBE TO TP17 (SOD) TO SEE IF µP IS RUNNING
DOES DATA PROBE FLASH?
NO
REMOVE FREE-RUN JUMPER U9 AND TOUCH DATA PROBE TO TP24 (RD)
DOES DATA PROBE FLASH?
YES
TROUBLESHOOT THE ADDRESS & DATA BUSES, U7, U8, U12, AND U3-U5. REFER TO TABLES 7-8 AND 7-9.
NO
CHECK µP INPUTS & OUTPUTS
YES
SETUP THE 5004 AS FOLLOWS:
START: TP17, TRIG.
STOP: TP17, TRIG.
CLOCK: TP9, TRIG.
GROUND: TP21
IS SIGNATURE 225F?
YES
REMOVE FREE-RUN JUMPER U9, AND TEST ADDRESS DE-CODER U7. REFER TO TABLES 7-8 AND 7-9.
IS U7 OK?
NO
REPLACE U7
YES
RAM U2 AND/OR U3 BAD
NO
IS SIGNATURE 4969
YES
REMOVE FREE-RUN JUMPER U9, AND TEST ADDRESS DE-CODER U7. REFER TO TABLES 7-8 AND 7-9.
IS U7 OK?
NO
REPLACE U7
YES
ROM U5 BAD
NO
A
A
IS SIGNATURE 13PH?
YES
REMOVE FREE-RUN JUMPER U9, AND TEST ADDRES CODER U7. TO TABLES 7- AND 7-9.
IS U7 OK?
NO
REPLACE
YES
U17 BAD
NO
IS SIGNATURE A8H3?
NO
USING DATA PROBE, CHECK START, STOP, & CLOCK INPUTS TO 5004
DOES DATA PROBE FLASH?
NO
REPAIR INPUT(S)
YES
PERFORM 5004 SELF TEST. REFER TO 5004 SERVICE MANUAL.
YES
TROUBLESHOOT I/O PORTS AND GPIB LED DRIVERS. REFER TO TABLES 7-10 AND 7-11.

Figure 7-28. Error Code 24 Troubleshooting Flowchart

Figures 7-26 & 7-27

7-8.2 A1 GPIB Interface PCB, Troubleshooting Information and Data

Error Code 24 reports on the status of the A1 GPIB Interface PCB. The microprocessor routine associated with this error code initiates a subroutine (Figure 7-29) that tests the A1 RAM, ROM, and 8291 circuits. The test equipment setup for troubleshooting Error Code 24 is provided in Figure 7-26 (facing page); the troubleshooting flowchart is provided in Figure 7-28.

Signature analysis is the recommended method for troubleshooting A1 circuits. In addition to a free-run mode (explained in HP Application Note 222-2), the A1 PCB also has a service mode. In this mode, routines stored in ROM U5 provide two methods for isolating to faulty components.

The first method uses a "loop-on-fail" technique (Figure 7-27) that allows the signature analyzer to quickly isolate a malfunctioning RAM, ROM, or 8291 GPIB Interface IC circuit. In this method, the signature analyzer will display one of four characteristic (Vcc) signatures, depending on which loop is being executed. If no faults are found, a specific signature is displayed. A fault in either the RAM, ROM, or 8291 provides a signature that is different for each.

The second service-mode method, a routine which writes to the output ports, input ports, and retrace-blanking flip flop, provides for signature analysis of these components. These tests are contained in Tables 7-10 thru 7-12 respectively.

For free-run signature analysis, two tables of signatures are provided. Tables 7-8 and 7-9 respectively provide signatures for the microprocessor's read and write spaces. Both of these tables provide test and signature analyzer setup conditions. When these conditions are met, a characteristic (Vcc) signature will be displayed; the microprocessor circuit may then be accurately tested.

In addition to signatures, the 5004A Signature Analyzer data probe may be used like a logic probe. When a circuit node is touched, the

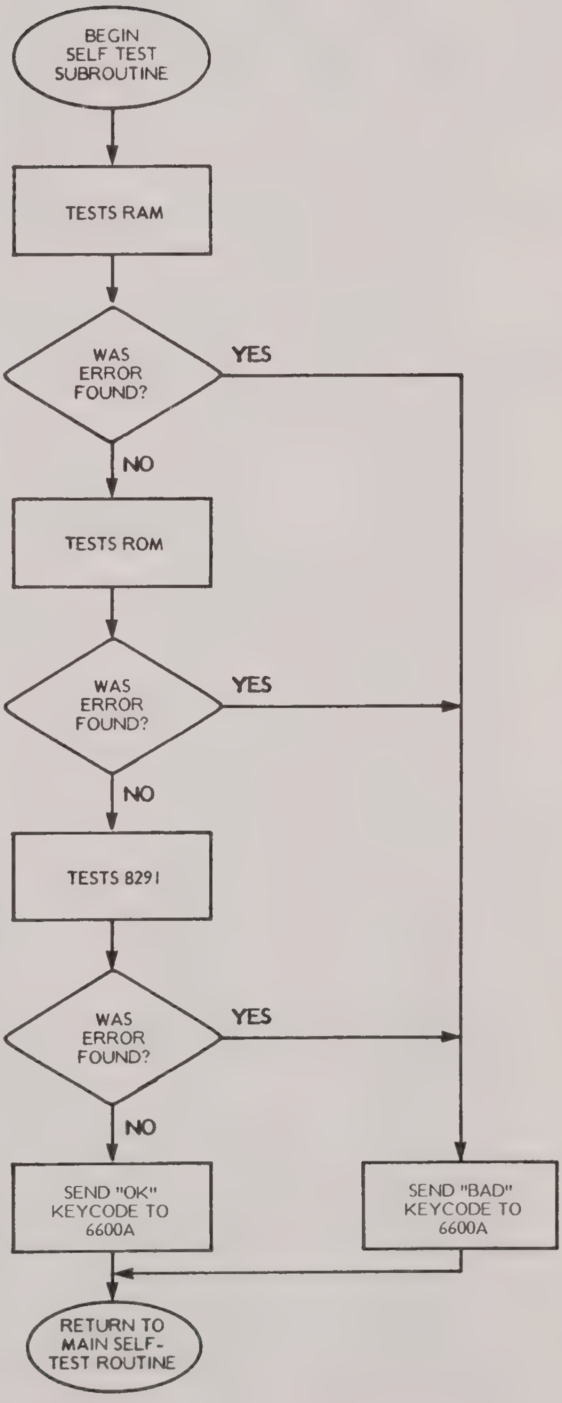

BEGIN SELF TEST SUBROUTINE
TESTS RAM
WAS ERROR FOUND?
YES
NO
TESTS ROM
WAS ERROR FOUND?
YES
NO
TESTS 8291
WAS ERROR FOUND?
YES
NO
SEND "OK" KEYCODE TO 6600A
SEND "BAD" KEYCODE TO 6600A
RETURN TO MAIN SELF-TEST ROUTINE

Figure 7-29. A1 PCB Self-Test Subroutine

probe tip will either flash, light steadily, or not be lit. A steadily-lit probe indicates a logic 1 or Vcc. An unlit probe indicates a logic 0 or ground. And a flashing probe usually indicates pulses; however, it can also indicate noise. A noise indication sometimes occurs when the probe is touched to an open node, or when it is touched to a tri-state-buffer node where the buffer is in its off state. When testing such nodes, the 5004A will read the Vcc signature when its RESET button is pressed. To help minimize probe noise pickup, ground the probe at the same point the test pod is grounded.

Table 7-8. A1 PCB Free-Run Mode Signatures – Read Space Test

Test Conditions: SERVICE-NORMAL switch in NORMAL.
Free-run jumper U9 removed.

Signature Analyzer Setup:
START: Bit A15 (TP15), Trigger ⎺╲⎽ (Button In)
STOP: Bit A15 (TP15), Trigger ⎺╲⎽ (Button Out)
CLOCK: $\overline{RD}$ (TP24), Trigger ⎽╱⎺ (Button Out)
GROUND: TP21 (Test Pod and Probe)
Vcc Signature: 755U

NOTES

[1] Test probe flashes.
[2] Signature may be unstable.
[3] May have to press RESET on probe.

IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE
U2	1	0772	U5	19	HH86	U8	1	0000		20	0000		10	0000
	2	7050		20	0000[1]		2	H335		21	7707		11	755U
	3	C113		21	755U		3	755U[1]		22	577A		13	755U
	4	H335		22	577A		4	755U[1]		23	HH86		15	0000
	5	AA08		23	7707		5	C113		24	89F1		17	0000
	6	7211		24	755U		6	7050		25	AC99		19	9181
	7	A3C1					7	755U[1]		26	PCF3		20	755U
	8	0000	U6	1	0000		8	755U[1]		27	1180			
	9	0000		2	F615		9	0772		28	0000[1]	U17	1	755U
	10	P352		3	HH86		10	0000		29	755U		2	755U
	15	P352		4	755U		11	0000[1]		30	0000[1]		3	755U[1]
	16	755U		5	755U		12	C4C3		31	755U		4	0000
	17	C4C3		6	755U		13	755U[1]		32	0000[1]		5	0000
	18	755U		7	755U		14	755U[1]		33	755U		6	755U
				8	755U		15	AA08		34	0000		7	755U
U3	1	0772		9	2HU0		16	7211		35	755U		8	8UH9
	2	7050		10	CF3F		17	755U[1]		36	755U		9	0000[1]
	3	C113		11	9181		18	0000[1]		37	755U[1]		10	755U
	4	H335		12	C307		19	A3C1		38	0000		11	0000[1]
	5	AA08		13	577A		20	755U		39	0000		20	0000
	6	7211		14	F615					40	755U		21	H335[2]
	7	A3C1		15	0000[1]	U12	1	755U[1]					22	C113[2]
	8	0000		16	755U		2	0000[1]	U15	1	CF3F		23	7050
	9	0000					3	0000		2	755U[1]		24	755U
	10	P352	U7	1	89F1		4	755U		4	755U		25	755U
	15	P352		2	AC99		5	0000		6	755U		26	755U
	16	755U		3	PCF3		6	0000		8	755U		27	0000
	17	C4C3		4	1180		7	0000		10	0000		28	0000
	18	755U		5	0000[1]		8	0000		11	755U		29	0000
				6	755U		9	0000		13	755U		30	0000
U5	1	A3C1		7	6F7P		10	0000		15	755U		31	755U
	2	7211		8	0000		11	755U		17	755U		32	755U
	3	AA08		9	F615		12	755U[1]		19	CF3F		33	0000
	4	C4C3		10	2F25		13	755U[1]		20	755U		34	0000
	5	0772		11	8UH9		14	755U[1]					35	755U
	6	7050		12	340A		15	755U[1]	U16	1	9181		36	755U
	7	C113		13	P352		16	755U[1]		2	0000		37	755U
	8	H335		14	U1U2		17	755U[1]		4	755U		38	755U
	12	0000		15	4CP2		18	755U[1]		6	755U[3]		39	755U
	18	4CP2		16	755U		19	0000[1]		8	755U[1]		40	755U

Table 7-9. A1 PCB Free-Run Mode Signatures – Address Space Test

Test Conditions: SERVICE-NORMAL switch in NORMAL.
Free-run jumper U9 removed.

Signature Analyzer Setup:

START: Bit A15 (TP15), Trigger ⎺╲⎽ (Button In)
STOP: Bit A15 (TP15), Trigger ⎽╱⎺ (Button Out)
CLOCK: ALE (TP18), Trigger ⎺╲⎽ (Button In)
GROUND: TP21 (Test Pod and Probe)

Vcc Signature: 755U

NOTES

[1] Test probe flashes.
[2] Signature may be unstable.
[3] May have to press RESET on probe.

IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE	IC	PIN NO.	SIGNATURE
U2	1	0772	U5	12	0000	U8	1	0000	U12	29	755U	U16	16	755U
	2	7050		13	755U[2]		2	H335		30	755U[1]		17	0000
	3	C113		14	755U[2]		3	H335		31	755U		18	Unstable
	4	H335		15	755U[2]		4	C113		32	755U[1]		19	755U[1]
	5	AA08		16	Unstable		5	C113		33	755U		20	755U
	6	7211		17	Unstable		6	7050		34	0000			
	7	A3C1		18	4CP2		7	7050		35	755U	U17	1	755U
	8	0000		19	HH86		8	0772		36	755U		2	755U
	9	755U[1]		20	755U[1]		9	0772		37	755U[1]		3	755U[1]
	10	P352		21	755U		10	0000		38	0000		4	0000
	11	755U[2]		22	577A		11	755U[1]		39	0000		5	0000
	12	755U[2]		23	7707		12	C4C3		40	755U		6	0000
	13	755U[2]		24	755U		13	C4C3					7	755U
	14	Unstable					14	AA08	U15	1	755U[1]		8	8UH9
	15	P352	U6	1	0000		15	AA08		2	755U[1]		9	755U[1]
	16	755U		2	F615		16	7211		3	755U[2]		10	755U
	17	C4C3		3	HH86		17	7211		4	755U		11	0000
	18	755U		4	755U		18	A3C1		5	755U[2]		12	755U[2]
				5	755U		19	A3C1		6	755U		13	755U[2]
U3	1	0772		6	755U		20	755U		7	755U[2]		14	755U[2]
	2	7050		7	755U					8	755U		15	Unstable
	3	C113		8	0000	U12	1	755U[1]		9	Unstable		16	755U[2]
	4	H335		9	755U[1]		2	0000[1]		10	0000		17	755U[2]
	5	AA08		10	755U[1]		3	0000		11	755U		18	755U[2]
	6	7211		11	755U[1]		4	755U		12	755U[1]		19	Unstable
	7	A3C1		12	755U[1]		5	0000		13	755U		20	0000
	8	0000		13	577A		6	0000		14	755U[1]		21	H335
	9	755U[1]		14	F615		7	0000		15	755U		22	C113
	10	P352		15	755U[1]		8	0000		16	755U[1]		23	7050
	11	755U[2]		16	755U		9	0000		17	755U		24	755U
	12	755U[2]					10	0000		18	Unstable		25	755U
	13	755U[2]	U7	1	89F1		11	755U		19	755U[1]		26	755U
	14	Unstable		2	AC99		12	H335		20	755U		27	0000
	15	P352		3	PCF3		13	C113					28	0000
	16	755U		4	1180		14	7050	U16	1	755U[1]		29	0000
	17	C4C3		5	0000[1]		15	0772		2	0000		30	0000
	18	755U		6	755U		16	C4C3		3	755U[2]		31	755U
				7	6F7P		17	AA08		4	755U		32	0000
U5	1	A3C1		8	0000		18	7211		5	755U[2]		33	0000
	2	7211		9	F615		19	A3C1		6	755U		34	0000
	3	AA08		10	2F25		20	0000		7	755U[2]		35	755U
	4	C4C3		11	8UH9		21	7707		8	755U[1]		36	755U
	5	0772		12	340A		22	577A		9	Unstable		37	755U
	6	7050		13	P352		23	HH86		10	0000		38	755U
	7	C113		14	U1U2		24	89F1		11	755U		39	755U
	8	H335		15	4CP2		25	AC99		12	755U		40	755U
	9	755U[1]		16	755U		26	PCF3		13	755U			
	10	755U[1]					27	1180		14	755U			
	11	755U[1]					28	0000[1]		15	0000			

Table 7-10. A1 PCB Output-Port Test

Purpose: This test verifies whether the A1 PCB is outputting data to the A12 Microprocessor.

Test Conditions: SERVICE-NORMAL switch in SERVICE mode.
Free-run jumper U9 installed.

Signature Analyzer Setup:

START: U7, Pin 9 (TP16), Trigger _/‾ (Button Out)

STOP: SOD (TP17), Trigger _/‾ (Button Out)

CLOCK: $\overline{WR}$ (TP23), Trigger _/‾ (Button Out)

GROUND: TP21 (Test Pod and Probe)

Vcc Signature: C637

NOTE

If the 5004 reads identical signatures (other than Vcc) on successive IC pins, or if the probe does not flash when a signature (other than Vcc) is read, check the front panel GPIB indicators. Correct status is: TALK, LISTEN, and LOCAL LOCKOUT brightly lit; SRQ and REMOTE dimly lit. If this is not the case, recycle both the A1 and A12 SERVICE-NORMAL switches.

IC	PIN NO.	SIGNATURE	IC	NO.	PIN SIGNATURE	IC	PIN NO.	SIGNATURE
U22	1	C637*	U22	15	29F0	U24	8	29F0
	2	9UU5	(Cont'd)	16	9UU4		9	0000*
	3	C637*		17	0000*		10	0000
	4	C637*		18	C637*		11	51P2
	5	29F1		19	29F1		12	C637
	6	9UU5		20	C637		13	9UU4
	7	C637*					14	29F0
	8	C637*	U24	1	C637*		15	C637
	9	29F0		2	C637*		16	C637
	10	0000		3	9UU5		17	9UU4
	11	C637*		4	29F1		18	29F1
	12	9UU4		5	C637*		19	C637*
	13	0000		6	C637*		20	C637
	14	C637*		7	9UU5			

* Logic Probe flashes.

Table 7-11. A1 PCB Input Port Test

Purpose: This test can be used to check whether the A1 PCB is responding to inputs from the GPIB.

Test Conditions: SERVICE-NORMAL switch in SERVICE mode.
Free-run jumper U9 installed.

Signature Analyzer Setup:

START: LDOR SEL (TP25), Trigger ↓ (Button In)

STOP: L STATUS SEL (TP26), Trigger ↑ (Button Out)

CLOCK: $\overline{\text{RD}}$ (TP24), Trigger ↑ (Button Out)

GROUND: TP21 (Test Pod and Probe)

Vcc Signature: 72A2

NOTE

If the 5004 reads identical signatures (other than Vcc) on successive IC pins, or if the probe does not flash when a signature (other than Vcc) is read, check the front panel GPIB indicators. Correct status is: TALK, LISTEN, and LOCAL LOCKOUT brightly lit; SRQ and REMOTE dimly lit. If this is not the case, recycle both the A1 and A12 SERVICE-NORMAL switches.

Procedure:

1. Set up test equipment as shown in Figure 7-26.
2. Sequentially touch the data probe to TP1 thru TP7; verify that each test point exhibits a stable signature.
3. Using controller, send the following statements over the bus:

```
10 OUTPUT 705 ;"FUL"
20 GOTO 10
30 END
```

4. Recheck the above test points and verify that TP2 thru TP7 exhibit unstable signatures.

Table 7-12. A1 PCB Retrace Blanking Flip-Flop Test

Purpose: This test verifies whether the Retrace Blanking FF (U23) is working properly.

Test Conditions: SERVICE-NORMAL switch in SERVICE mode.
Free-run jumper U9 installed.

Signature Analyzer Setup:

START: SOD (TP17), Trigger ↘ (Button In)

STOP: SOD (TP17), Trigger ↘ (Button In)

CLOCK: CLOCK (OUT) (TP9), Trigger ↗ (Button Out)

GROUND: TP21 (Test Pod and Probe)

Vcc Signature: A8H3

NOTE

If the 5004 reads identical signatures (other than Vcc) on successive IC pins, or if the probe does not flash when a signature (other than Vcc) is read, check the front panel GPIB indicators. Correct status is: TALK, LISTEN, and LOCAL LOCKOUT brightly lit; SRQ and REMOTE dimly lit. If this is not the case, recycle both the A1 and A12 SERVICE-NORMAL switches.

IC	PIN NO	SIGNATURE	IC	PIN NO.	SIGNATURE
U23	1	0000	U23	9	6725
	2	0000		10	A8H3
	3	A8H3		11	A8H3
	4	A8H3		12	0000
	5	0000		13	A8H3
	6	0000		14	OFHP
	7	FU56		15	89C8
	8	0000		16	A8H3

* Logic Probe LED flashes.

7-9 A2 RAMP GENERATOR PCB

7-9.1 A2 Ramp Generator PCB, Circuit Description

The A2 Ramp Generator PCB generates one of the voltage-tuning signals used to produce the sweep generator's sweep-frequency output. The PCB also generates the **RETRACE BLANKING (+), (-); BANDSWITCH BLANKING (+), (-);** and **SEQ SYNC** signals that are output to the respective rear panel connectors. A functional block diagram of this PCB is shown in Figure 7-32; the schematic diagram (3 sheets) is shown in Figure 7-33. The A2 PCB consists of three functional blocks (Figure 7-32), which are described below.

a. Ramp Generator. This functional block produces the PCB sweep ramp output signal and the two retrace blanking pulses that are supplied to the RETRACE BLANKING (+) and (-) rear panel connectors. The block also provides control for the relay connected to the rear panel PENLIFT OUTPUT connector. The input to this functional block is the front panel SWEEP TIME control group from the A12 Microprocessor PCB. Eight bits of this nine-bit group are latched into the digital-to-analog converter (DAC) circuit (U15) when the microprocessor clocks **SP13** HIGH. The DAC output is a negative voltage that causes the Sweep Ramp

Integrator (U20B) to integrate in the positive direction. When the sweep ramp reaches 10 volts, the 10V Compare circuit (U25B, U25C) causes the Sweep Direction and Dwell Gating circuit (U24A, U24B, U2A, U2B, U17C) to open Switch A and close Switch B. This switching action causes the integrator to then integrate in the negative direction (retrace). When this negative-going ramp reaches 0 volts, the 0V Compare circuit (U25D, U25A) then causes Switch B to open and Switch A to close – a switch arrangement that reconfigures the integrator to again integrate in the positive direction. A typical sweep ramp waveform is shown in Figure 7-30.

The **1 SECOND CONTROL** bit (the ninth bit in the SWEEP TIME group) is a >1- or <1-second flag bit. For sweep speeds between 1 and 99 seconds, this bit is HIGH. This HIGH causes the Sweep Ramp Integrator to integrate at the slower sweep-time rate.

The Retrace Blanking Logic circuit (Q2, U10C) causes both a plus (+) and a minus (-) 5 volt pulse to be generated during sweep retrace. The same signal that opens Switch A initiates these retrace blanking pulses.

The **H SWP** bit goes TRUE (high) to indicate when a forward sweep is in progress. This bit is supplied to the A12 Microprocessor, where it causes the front panel SWEEPING indicator to light.

The Activate Relay Logic circuit (Q3) controls relay A14K1, which is the relay that connects to the rear panel PENLIFT OUTPUT connector. This circuit has two purposes. First it activates A14K1, thus causing the XY recorder's pen to drop, when (1) the sweep generator is in the EXT OR SINGLE sweep mode, (2) sweep speed is greater than 1 second, and (3) a forward sweep occurs (**H SWP** line goes TRUE). Second it deactivates A14K1, thus causing penlift to occur, when the single-sweep ramp is interrupted and reset. To accomplish the first purpose, the circuit holds the relay deactivated (NO contacts open and NC contacts closed) when any of the following occur:

1. The **1 SECOND CONTROL** bit is LOW (sweep speeds between 10 ms and 1 s).
2. The **H SWP** bit is false (forward sweep not in progress).
3. The H **RESET** bit is TRUE (single-sweep is reset, subparagraph c below).
4. THE TRIGGER **EXT OR SINGLE SWEEP** control-word bit is not HIGH (subparagraph c below).

To accomplish the second purpose, a flip-flop circuit (U27A, U26A, U26B) deactivates the relay when reset occurs while a forward sweep is in progress (**L 10V COMPARE** line is FALSE).

b. Sweep Dwell and Related Circuits. The sweep dwell circuit causes the sweep ramp to dwell when:

1. The end of an oscillator band (EOB) is reached (bandswitch point).
2. An intensity marker command is received.
3. The top of the sweep ramp (10V) is reached.
4. The bottom of the sweep ramp (0V) is reached.

When any one of the above dwell conditions is detected, the Initiate Dwell circuit (U16B, U17A, U22A, U22B, U23A) sets the **H DWELL** line TRUE. When TRUE, **H DWELL** causes the following:

(a) The Sweep Direction and Dwell Gating circuit (U24A, U24B, U2A, U2B, U17C, U10E) to open Switch A and Switch B. Opening these switches causes voltage integration of the sweep ramp to halt;

(b) The 4 kHz clock in the Dwell Timing circuit (U3) to run at 144 kHz; thereby initiating a timing sequence.

The timing sequence initiated by the speeded-up clock consists of two timing

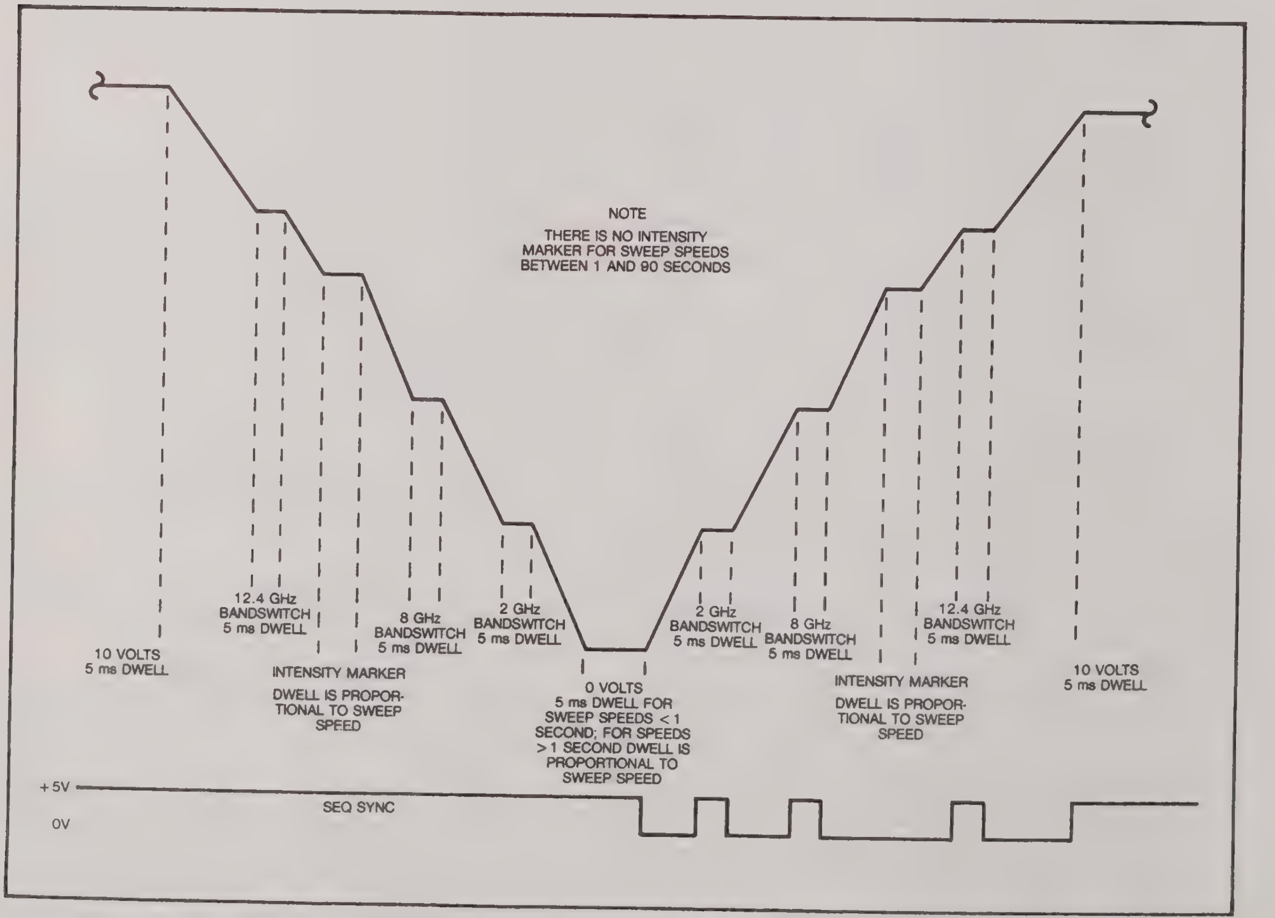

NOTE
THERE IS NO INTENSITY MARKER FOR SWEEP SPEEDS BETWEEN 1 AND 90 SECONDS
10 VOLTS 5 ms DWELL
12.4 GHz BANDSWITCH 5 ms DWELL
8 GHz BANDSWITCH 5 ms DWELL
2 GHz BANDSWITCH 5 ms DWELL
INTENSITY MARKER DWELL IS PROPORTIONAL TO SWEEP SPEED
0 VOLTS 5 ms DWELL FOR SWEEP SPEEDS < 1 SECOND; FOR SPEEDS > 1 SECOND DWELL IS PROPORTIONAL TO SWEEP SPEED
2 GHz BANDSWITCH 5 ms DWELL
8 GHz BANDSWITCH 5 ms DWELL
INTENSITY MARKER DWELL IS PROPORTIONAL TO SWEEP SPEED
12.4 GHz BANDSWITCH 5 ms DWELL
10 VOLTS 5 ms DWELL
+5V
0V
SEQ SYNC

Figure 7-30. A2 PCB Sweep Ramp and Sequential Sync Pulse

pulses: **TP2** and **TP4.** The first-occurring pulse, **TP2**, loads the dwell word (described below) into the Down Counter (U9, U13). And the second-occurring pulse, **TP4**, both resets the clock to 4 kHz and enables the Down Counter. When enabled, the Down Counter sequentially counts down each time it is clocked. When a zero count is reached, the **U11 CLOCK** line is gated HIGH, which clocks the **L STRB** output from the Ext Sweep Logic circuit (U11A) TRUE. This **L STRB** output is applied to the Sweep Trigger Control Decoder circuit (U19) (subparagraph c below). Refer to Figure 7-31 for a simplified schematic and description of the Dwell-Timing circuit.

The dwell word that **TP2** loads into the Down Counter is either of two values, as determined by the Sel Logic circuit (U26C, U26D). If either (1) the sweep ramp is at 0V and the sweep time is greater than 1 second or (2) an intensity marker has been commanded, the dwell word's value represents the sweep time. Otherwise, the dwell word's value is 5 ms.

The related circuits in this block are the Level Dip circuit (U1A), the Seq Sync Logic (U23B, U5D, Q4), and the Bandswitch Blanking (Q5, Q6) circuits. The Level Dip circuit outputs a LOW when clocked by an **EOB** pulse. This LOW causes the A4 PCB to "dip" the RF output power during oscillator bandswitch.

The Seq Sync Logic circuit outputs a +5V pulse (Figure 7-30) during oscillator bandswitch, 0- and 10-volt dwell periods, and sweep ramp retrace. This pulse goes to the A1 PCB (**H SEQ**) and to the rear panel SEQ SYNC connector.

The Retrace Blanking circuit outputs plus and minus (+, -) 5V pulses during sweep ramp retrace. These pulses go to the respective rear panel connectors.

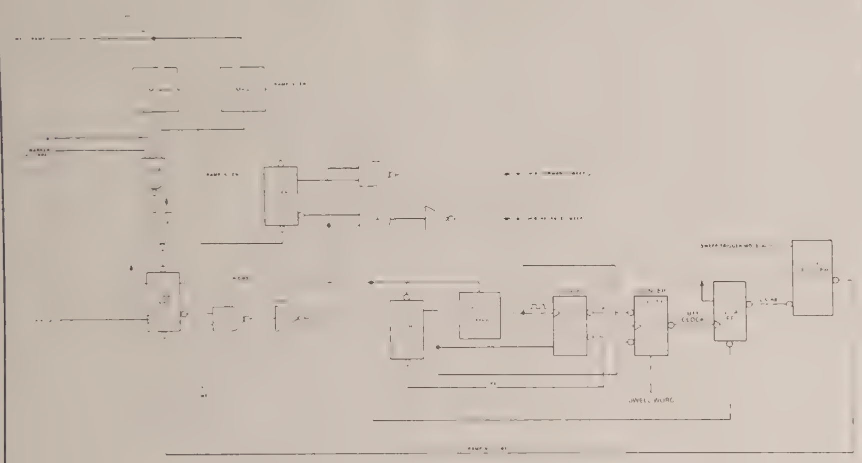
c. Sweep Trigger Control. This functional block controls the recurrence of the A2 PCB sweep ramp. The input to this block is an 8-bit control group from the A12 Microprocessor PCB. This word is latched into the Control Word Latch and Logic circuit (U14, U2C, U5F) when the microprocessor clocks **SP14** HIGH. Of these eight bits, five comprise the TRIGGER group (AUTO, LINE, or EXT OR SINGLE), one is the **1 SECOND CONTROL** bit (subparagraph b above), one is the **SEQ SYNC DISABLE** bit, and one is the **EXT FM DISABLE** bit. The **EXT FM DISABLE** bit is not used on this PCB; it is decoded here and sent to the A10 PCB. The **SEQ SYNC DISABLE** bit is used to activate the Seq Sync Disable Logic circuit (Q7). Three bits of the 5-bit control group go to the Decoder (U19), where they are used to control the trigger source. These 3 control-group bits are decoded by U19 when the **L STRB** line goes TRUE (low) (subparagraph b above). Once enabled by the **L STRB** line, U19 is controlled by the **H RAMP IS TEN** line. When TRUE, this line signals that the sweep ramp has reached its top end (10 volts). A chart showing the logic state of the **RAMP NOT DWELL** line for the various input-signal logic states is given in Table 7-13.

The remaining signal in this block is **H RESET.** This signal line pulses TRUE when the EXT OR SINGLE pushbutton is pressed while a sweep is in progress. When TRUE, **H RESET** initiates a dwell and, when the dwell period is finished, causes Switch A to close. When Switch A closes, the sweep ramp starts climbing toward 10 volts at a fast rate. When the ramp reaches 10 volts, the **L RAMP IS TEN** line enables a new sweep to be initiated when the EXT OR SINGLE pushbutton is again pressed.

Table 7-13. L RAMP NOT DWELL Logic States

STROBE U19-7	RAMP IS TEN U19-9	AUTO U19-15	LINE U19-10	EXT OR SINGLE U19-A	RAMP NOT DWELL U19-6
1	X*	X	X	X	1
0	0	X	X	X	0
0	1	1	0	0	0
0	1	X	1	0	0 Only when triggered by Line Trigger Pulse Generator. (U19-13 = 1)
0	1	X	0	1	0 Only when Single Sweep Logic circuit (U17D) has detected one of the following: a. An external trigger pulse from the rear panel. (U17D-12 = 0) b. An activate single-sweep logic level from the front panel, via the microprocessor. (U17D-13 = 0)

* = Don't Care



As an example to aid in tracing the logic of the Dwell Timing circuit, the following narrative describes circuit operation for a 10V dwell command.

The 10V Compare circuit senses when the sweep ramp reaches its upper limit of 10 volts. When this occurs the circuit outputs a LOW to U24A and U23A. This LOW clears the U24A "Q-bubble" output HIGH, and, via U23A and U17A, it presets the U16B "Q" output HIGH and "Q-bubble" output LOW. The LOW from U16B, via U17B and U10B, inhibits gates U2A and U17C. When inhibited these two gates cause both Switch A and Switch B to open, thus halting the sweep ramp.

The HIGH signal from U16B, **H DWELL**, is applied to U1B, U3, and U11A. At U3, it resets the Timer and causes it to output pulses. These pulses initiate a timing sequence. The first pulse in this sequence, TP2, loads the dwell word into downcounters U9 and U13. The second pulse, TP4, clears the U1B "Q" output LOW. This LOW enables the counter, which starts it counting down. when the countdown is complete, the U9/U13 "RIP" output goes LOW and clocks U11A. When clocked U11A outputs a LOW that enables U19 to decode the microprocessor-supplied sweep-trigger-mode data. If the sweep mode permits (Table 7-13), U19 sets the L RAMP NOT DWELL line TRUE. When TRUE this line clears U16B, thus setting the "Q-bubble" output HIGH and the "Q" output LOW. The HIGH enables U2A, allowing previously set HIGH on the U24A "Q-bubble" output to close Switch B. When closed Switch B causes the ramp to retrace toward zero volts.

Figure 7-31. Dwell-Timing Circuit, Simplified Schematic and Description

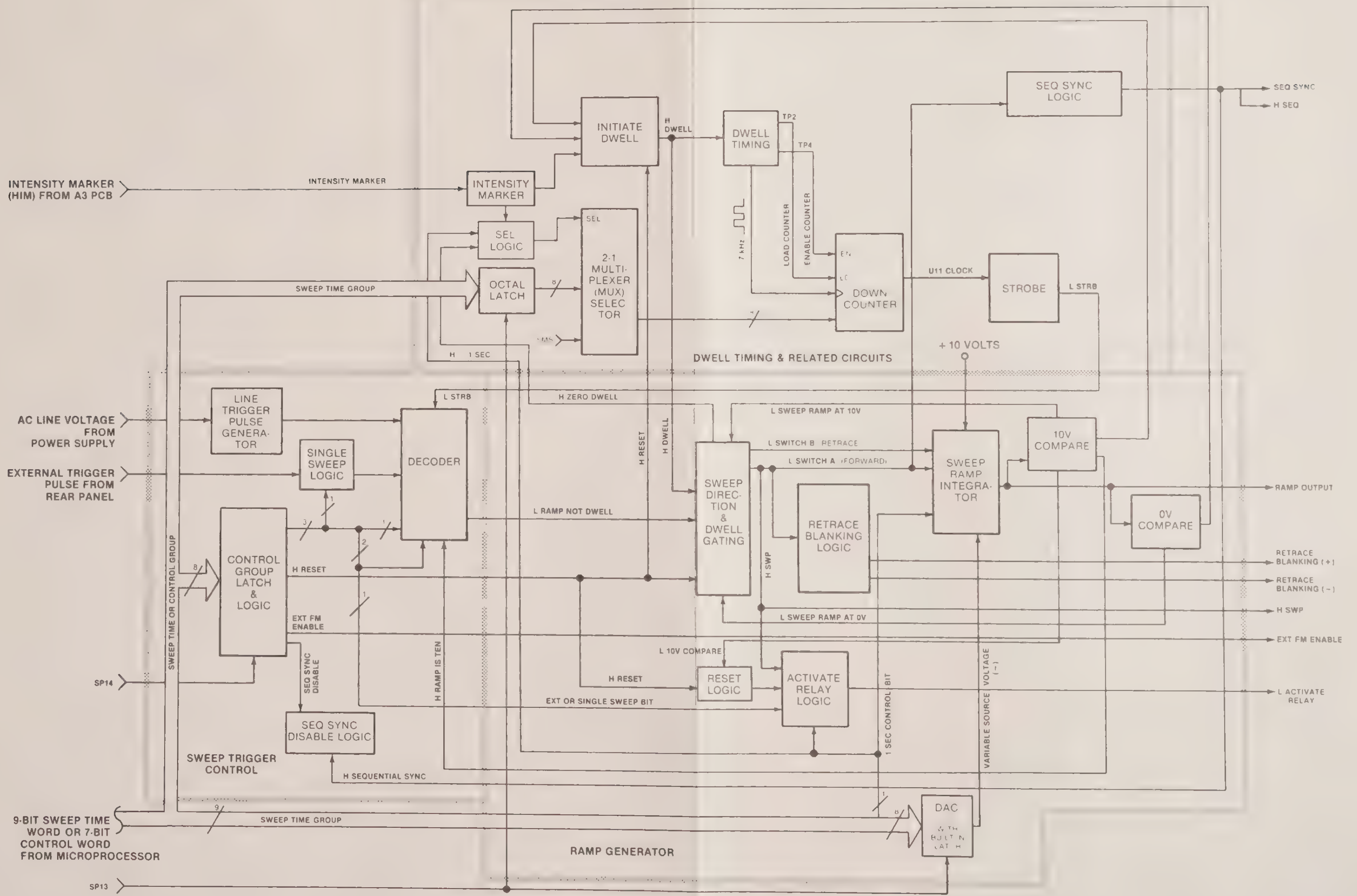
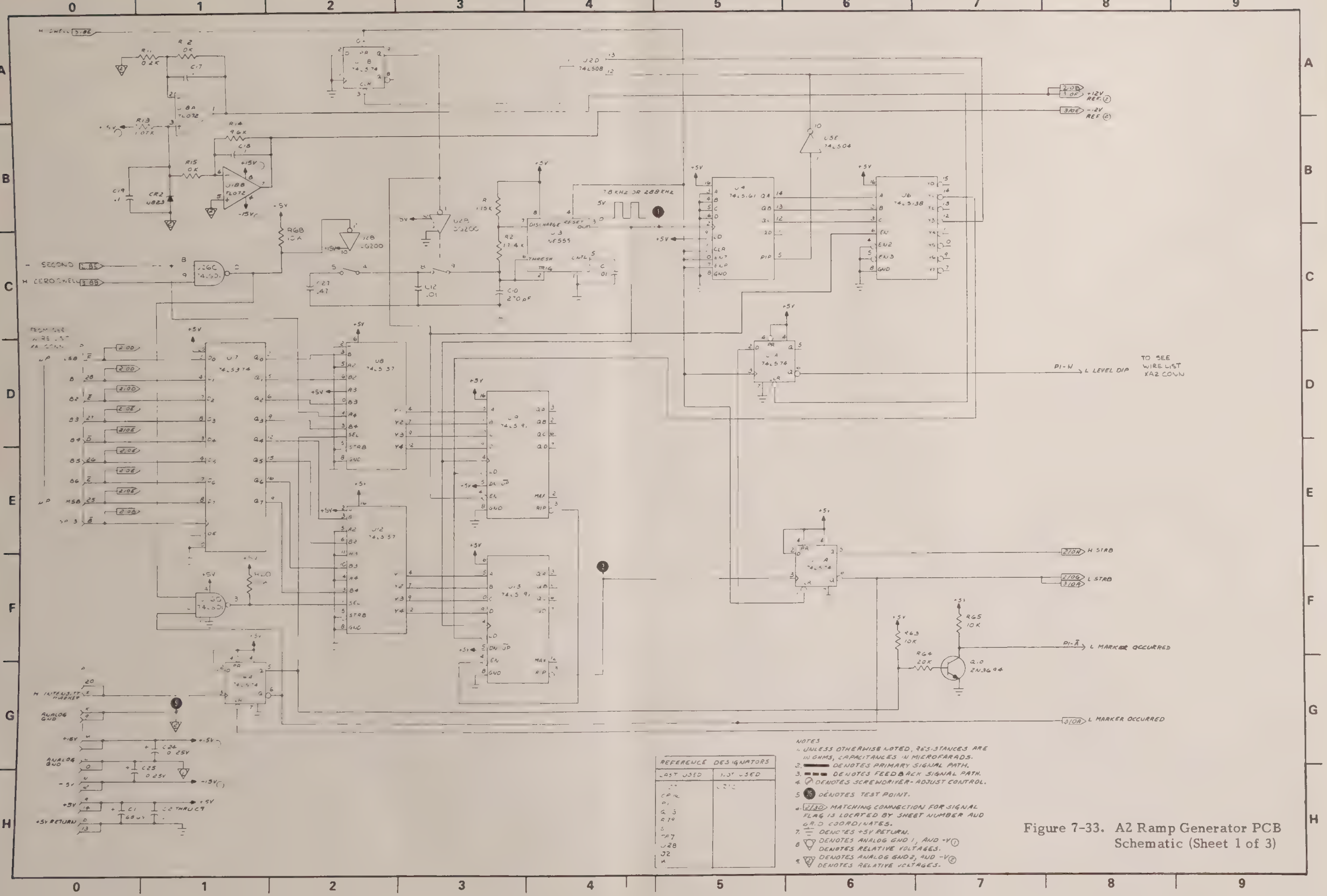

INTENSITY MARKER (HIM) FROM A3 PCB
INTENSITY MARKER
INTENSITY MARKER
INITIATE DWELL
H DWELL
DWELL TIMING
TP2
TP4
7 kHz
LOAD COUNTER
ENABLE COUNTER
EN
LC
DOWN COUNTER
U11 CLOCK
STROBE
L STRB
SEQ SYNC LOGIC
SEQ SYNC
H SEQ
SEL LOGIC
SEL
OCTAL LATCH
SWEEP TIME GROUP
8
2-1 MULTI-PLEXER (MUX) SELEC TOR
H 1 SEC
DWELL TIMING & RELATED CIRCUITS
+ 10 VOLTS
AC LINE VOLTAGE FROM POWER SUPPLY
EXTERNAL TRIGGER PULSE FROM REAR PANEL
LINE TRIGGER PULSE GENERA-TOR
SINGLE SWEEP LOGIC
DECODER
L STRB
H ZERO DWELL
CONTROL GROUP LATCH & LOGIC
SWEEP TIME OR CONTROL GROUP
H RESET
EXT FM ENABLE
SEQ SYNC DISABLE
SEQ SYNC DISABLE LOGIC
H SEQUENTIAL SYNC
H RAMP IS TEN
L RAMP NOT DWELL
H RESET
H DWELL
SWEEP DIREC-TION & DWELL GATING
L SWEEP RAMP AT 10V
L SWITCH B RETRACE
L SWITCH A (FORWARD)
RETRACE BLANKING LOGIC
H SWP
SWEEP RAMP INTEGRA-TOR
10V COMPARE
0V COMPARE
RAMP OUTPUT
RETRACE BLANKING (+)
RETRACE BLANKING (−)
H SWP
L SWEEP RAMP AT 0V
EXT FM ENABLE
L 10V COMPARE
H RESET
RESET LOGIC
ACTIVATE RELAY LOGIC
EXT OR SINGLE SWEEP BIT
L ACTIVATE RELAY
1 SEC CONTROL BIT
VARIABLE SOURCE VOLTAGE (−)
SP14
SWEEP TRIGGER CONTROL
9-BIT SWEEP TIME WORD OR 7-BIT CONTROL WORD FROM MICROPROCESSOR
SWEEP TIME GROUP
9
DAC WITH BUILT IN LATCH
RAMP GENERATOR
SP13

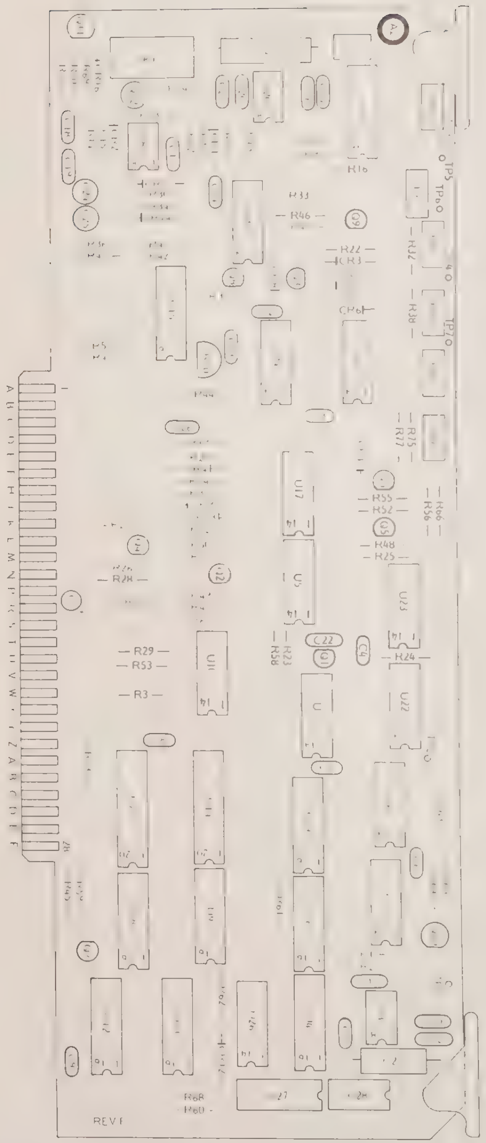
Figure 7-32. A2 Ramp Generator Functional Block Diagram

Figure 7-31


A
B
C
D
E
F
G
H
0
1
2
3
4
5
6
7
8
9
SECOND
H ZERO CHNL
NE555
74LS161
74LS138
74LS74
74LS04
U23
U28
+12V REF
-2V REF
TO SEE WIRE LIST
L LEVEL DIP
H STRB
L STRB
L MARKER OCCURRED
2N3644
+5V
-5V
+5V RETURN
ANALOG GND
REFERENCE DESIGNATORS
LAST USED
NOT USED
J2
U28

NOTES
1. UNLESS OTHERWISE NOTED, RESISTANCES ARE IN OHMS, CAPACITANCES IN MICROFARADS.
2. ▬▬ DENOTES PRIMARY SIGNAL PATH.
3. ▬ ▬ ▬ DENOTES FEEDBACK SIGNAL PATH.
4. ⊘ DENOTES SCREWDRIVER-ADJUST CONTROL.
5. ● DENOTES TEST POINT.
6. 2/10 MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
7. ⏚ DENOTES +5V RETURN.
8. ▽ DENOTES ANALOG GND 1, AND -V① DENOTES RELATIVE VOLTAGES.
9. ▽ DENOTES ANALOG GND 2, AND -V② DENOTES RELATIVE VOLTAGES.

Figure 7-33. A2 Ramp Generator PCB Schematic (Sheet 1 of 3)



A2 PCB Parts Locator Diagram

Figure 7-33 (Sheet 1 of 3)

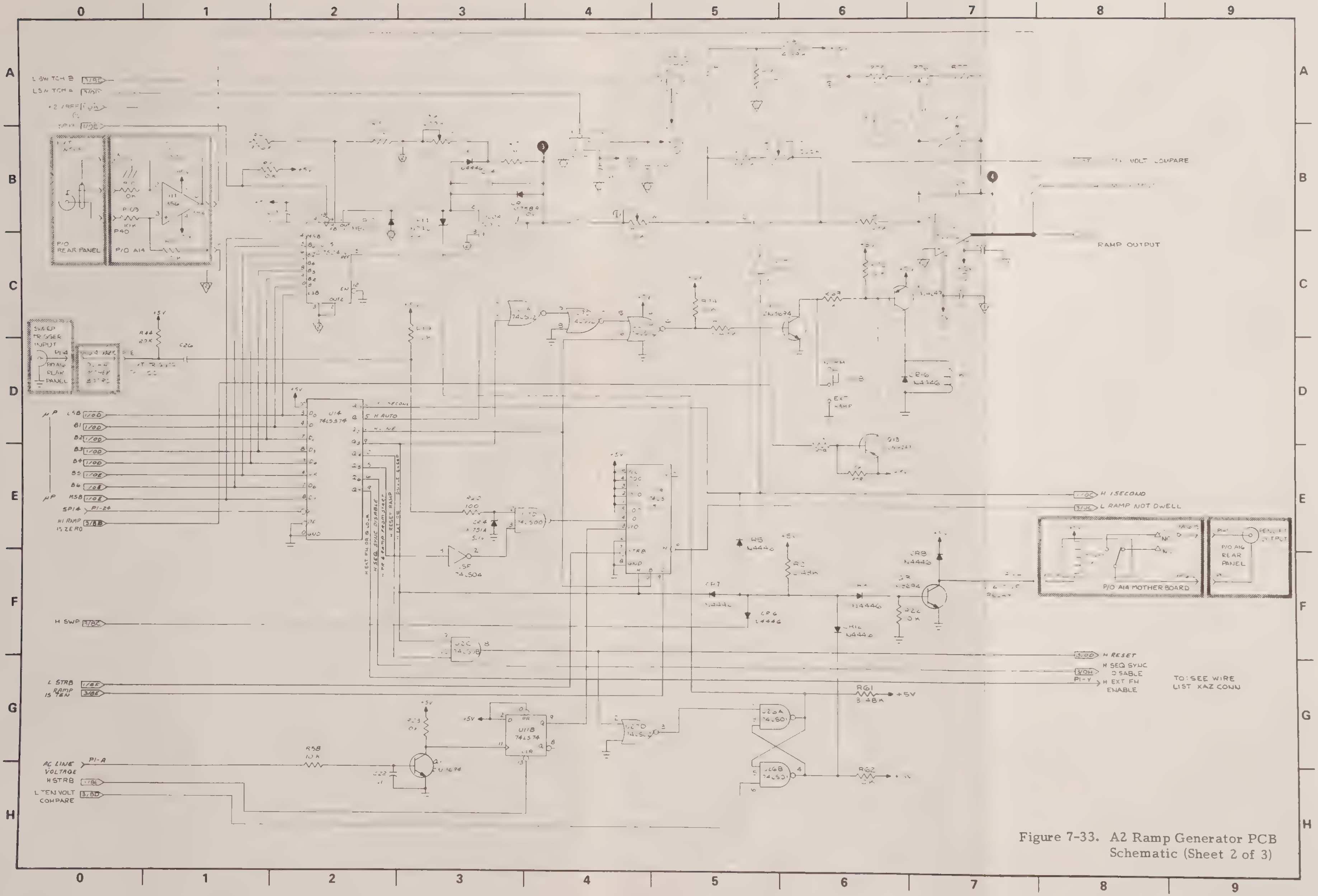

L SWITCH B
L SWITCH A
P/O REAR PANEL
P/O A14
P40
VOLT COMPARE
RAMP OUTPUT
SWEEP TRIGGER INPUT
P/O A16 REAR PANEL
R44
27K
C26
+5V
μP LSB 1/0D
B1 1/0D
B2 1/0D
B3 1/0D
B4 1/0D
B5 1/0E
B6 1/0E
μP MSB 1/0E
SP14 P1-24
HI RAMP IS ZERO 3/8B
U14
74LS374
H AUTO
H EXT FM OR B LOCK
H SEQ SYNC DISABLE
H RESET RAMP
H SWP 3/8C
L STRB 1/8E
RAMP IS TEN 3/8E
AC LINE VOLTAGE P1-A
H STRB 1/8E
L TEN VOLT COMPARE 3/8D
R58
10 K
C22
.1
U11B
74LS74
U26A
74LS01
U26B
74LS01
U2C
74LS10
74LS04
R20
100
CR4
1751A
5.1V
2N3694
CR16
IN4446
CR8
IN4446
CR5
IN4446
CR6
IN4446
CR7
IN4446
R61
3.48K
R62
H 1SECOND 1/0C
L RAMP NOT DWELL 3/0C
P/O A14 MOTHER BOARD
P/O A16 REAR PANEL
NC
H RESET 3/0D
H SEQ SYNC DISABLE 3/0H
P1-Y
H EXT FM ENABLE
TO: SEE WIRE LIST XAZ CONN

Figure 7-33. A2 Ramp Generator PCB Schematic (Sheet 2 of 3)

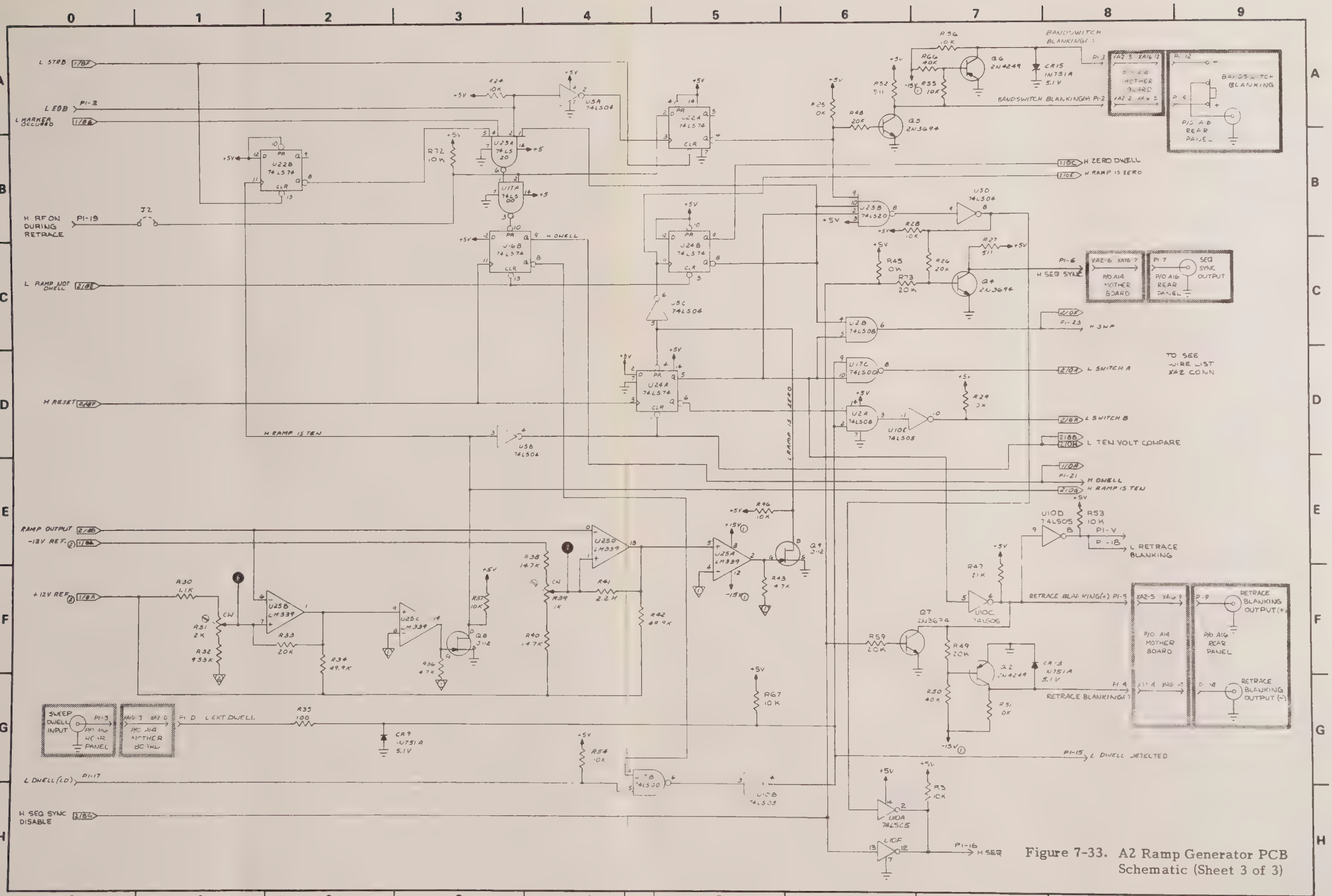
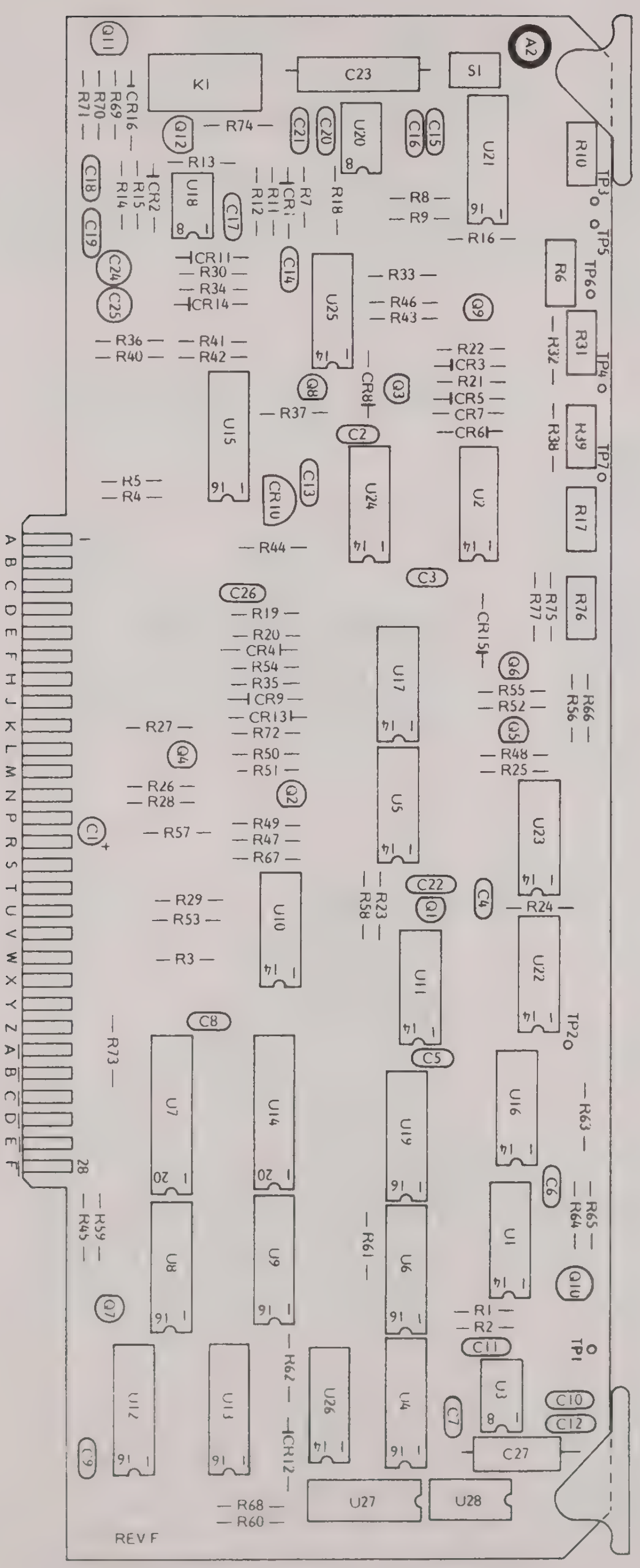

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
L STRB
1/87
L EOB
P1-2
L MARKER OCCURED
1/86
H RF ON DURING RETRACE
P1-19
J2
L RAMP NOT DWELL
2/8E
H RESET
2/8F
RAMP OUTPUT
-12V REF.
+12V REF.
SWEEP DWELL INPUT
P1-3
P/O A16 REAR PANEL
P/O A14 MOTHER BOARD
L EXT DWELL
L DWELL (LD)
P1-17
H SEQ SYNC DISABLE
U22B
74LS74
U23A
74LS20
U5A
74LS04
U22A
74LS74
U17A
74LS00
U16B
74LS74
U24B
74LS74
U5C
74LS04
U24A
74LS74
U5B
74LS04
H RAMP IS TEN
H DWELL
L RAMP IS ZERO
U23B
74LS20
U5D
74LS04
U2B
74LS08
U17C
74LS00
U2A
74LS08
U10E
74LS05
U25D
LM339
U25A
LM339
U25B
LM339
U25C
LM339
Q8
J112
Q9
J112
U10D
74LS05
U10C
74LS05
U10A
74LS05
U10F
U10B
74LS05
Q5
2N3694
Q6
2N4249
Q4
2N3694
Q7
2N3694
Q2
2N4249
CR15
1N751A
5.1V
CR13
1N751A
5.1V
CR9
1N751A
5.1V
R24 10K
R72 10K
R36 10K
R66 40K
R55 10K
R52 511
R25 0K
R48 20K
R28 10K
R27 511
R45 0K
R26 20K
R73 20K
R29 0K
R46 10K
R43 4.7K
R38 14.7K
R39 1K
R40 14.7K
R41 2.2M
R42 49.9K
R30 1.1K
R31 2K
R32 953K
R33 20K
R34 49.9K
R37 10K
R36 4.7K
R35 100
R54 10K
R67 10K
R47 21K
R53 10K
R59 20K
R49 20K
R50 40K
R51 0K
R3 10K
+5V
-15V
+15V
BANDSWITCH BLANKING(-)
BANDSWITCH BLANKING(+) P1-2
P1-3
XA2-3
XA16-12
P/O A14 MOTHER BOARD
P1-12
BANDSWITCH BLANKING
P/O A16 REAR PANEL
1/8C H ZERO DWELL
2/8E H RAMP IS ZERO
P1-6
H SEQ SYNC
XA2-6
XA16-7
P/O A14 MOTHER BOARD
P1-7
P/O A16 REAR PANEL
SEQ SYNC OUTPUT
2/10F
P1-23
H SWP
2/10A L SWITCH A
TO SEE WIRE LIST XA2 CONN
2/10B L SWITCH B
2/8B
2/10H
L TEN VOLT COMPARE
1/10A
P1-21
H DWELL
2/10G H RAMP IS TEN
P1-V
P-18
L RETRACE BLANKING
RETRACE BLANKING(+) P1-5
XA2-5
XA16-9
P/O A14 MOTHER BOARD
P-9
P/O A16 REAR PANEL
RETRACE BLANKING OUTPUT(+)
P1-4
RETRACE BLANKING(-)
XA2-4
XA16-8
P-4
RETRACE BLANKING OUTPUT(-)
P1-15
L DWELL DETECTED
P1-16
H SEQ
CW

Figure 7-33. A2 Ramp Generator PCB Schematic (Sheet 3 of 3)

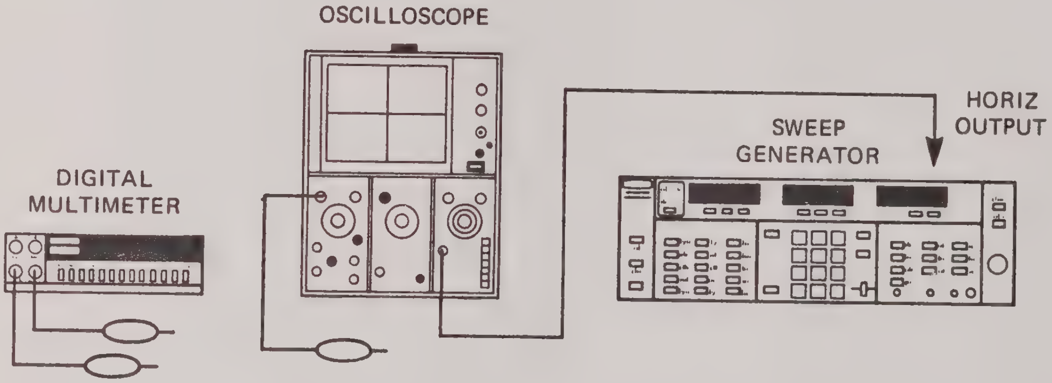

A2
K1
C23
S1
Q11
CR16
R69
R70
R71
Q12
R74
C21
C20
U20
C16
C15
U21
R10
TP3
TP5
R13
C18
CR2
R15
R14
U18
C17
R12
R11
CR1
R7
R18
R8
R9
R16
C19
R6
TP6
CR11
R30
R34
CR14
C24
C25
C14
U25
R33
R46
R43
Q9
R31
R32
R36
R40
R41
R42
R22
CR3
R21
CR5
CR7
CR6
TP4
Q8
CR8
Q3
U15
R37
R39
R38
C2
TP7
R5
R4
C13
CR10
U24
U2
R17
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
A
B
C
D
E
F
1
28
R44
C3
C26
R19
R20
CR4
R54
R35
CR9
CR13
R72
R50
R51
R76
R75
R77
CR15
U17
Q6
R55
R52
R66
R56
R27
Q4
Q5
R48
R25
R26
R28
Q2
U5
U23
C1
R57
R49
R47
R67
R29
R53
R3
U10
R23
R58
C22
Q1
C4
R24
U11
U22
TP2
C8
R73
U7
U14
C5
U19
U16
R63
C6
R65
R64
R59
R45
U8
U9
R61
U6
U1
Q10
Q7
R1
R2
C11
TP1
U12
U13
R62
U26
U4
U3
C10
C12
C7
C27
C9
CR12
U27
U28
R68
R60
REV F

A2 PCB Parts Locator Diagram

7-9.2 A2 Ramp Generator PCB, Troubleshooting Information and Data

Error code 21 reports on the status of the A2 Ramp Generator PCB. The microprocessor routine associated with this error code starts a sweep ramp, and then verifies that the ramp has occurred. The routine accomplishes this by starting an 8 ms ramp, and then – after a microprocessor-determined time – checking the **H SWP** and **L DWELL DETECTED** control lines. If the **H SWP** line has toggled from HIGH to LOW, a forward sweep has occurred. And if the **L DWELL DETECTED** line has toggled from LOW to HIGH, a retrace sweep has occurred.

The test setup for troubleshooting Error Code 21 is provided in Figure 7-34; the troubleshooting flowchart (2 sheets) is provided in Figure 7-35.



SWEEP GENERATOR CONTROL SETTINGS

FREQUENCY RANGE: FULL
TRIGGER: AUTO
MARKERS: VIDEO
LEVELING: INTERNAL
RETRACE RF: ON
RF: ON

RF SLOPE: OFF
LEVEL: 0 dBm
SWEEP TIME: 10 ms

Figure 7-34. Test Equipment Setup for Troubleshooting Error Code 21

GENERAL INSTRUCTIONS:

1. Check the following voltages before starting the flowchart:
    a. +5V - check at connector P1, pins R(+) and P(-),
    b. +15V - check at connector P1, pin M (reference measurement to pin L),
    c. -15V - check at connector P1, pin N (reference measurement to pin L).
2. Insure that the PCB-mounted INT-EXT switch (A2S1) is in INT.
3. Logic levels are TTL.
4. Verify +12V reference at U18, pin 1.
5. Verify -12V reference at U18, pin 7.

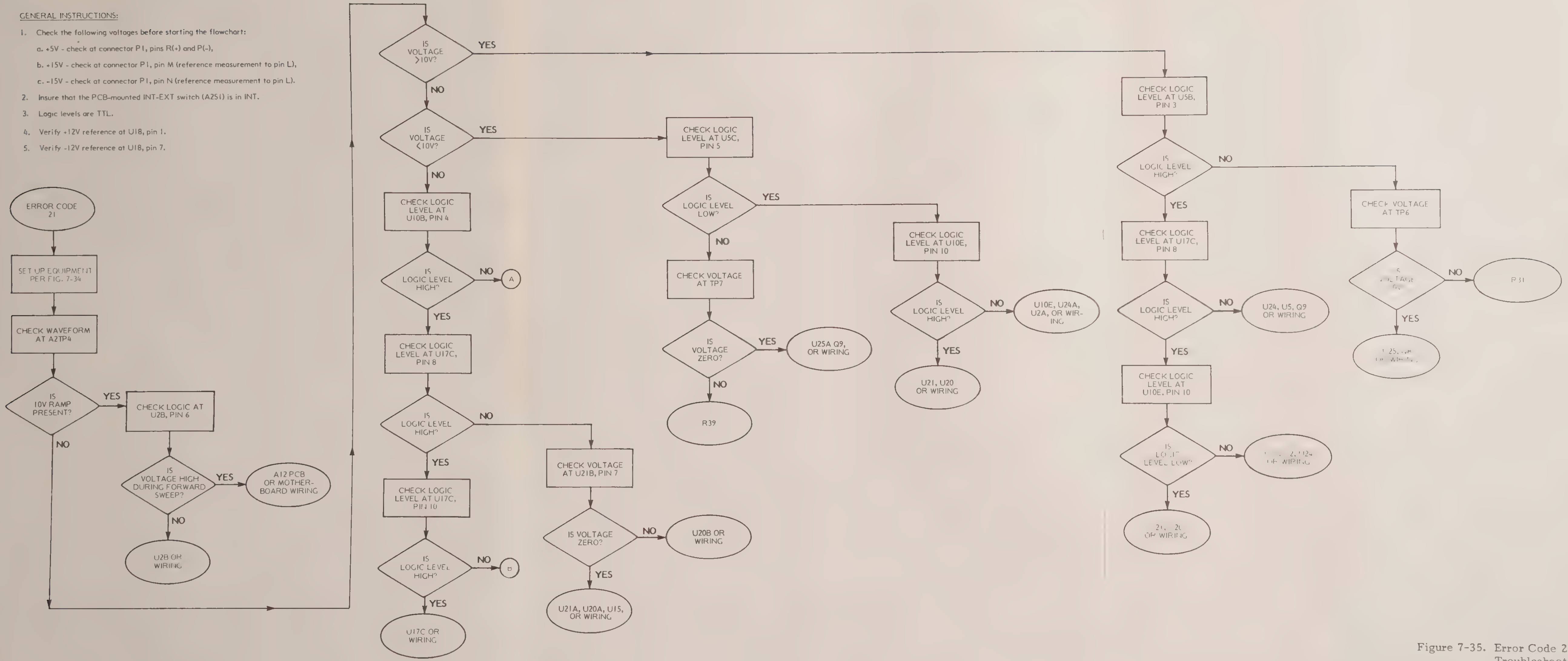

ERROR CODE 21
SET UP EQUIPMENT PER FIG. 7-34
CHECK WAVEFORM AT A2TP4
IS 10V RAMP PRESENT?
YES
NO
CHECK LOGIC AT U2B, PIN 6
IS VOLTAGE HIGH DURING FORWARD SWEEP?
YES
A12 PCB OR MOTHER-BOARD WIRING
NO
U2B OR WIRING
IS VOLTAGE >10V?
YES
NO
IS VOLTAGE <10V?
YES
NO
CHECK LOGIC LEVEL AT U10B, PIN 4
IS LOGIC LEVEL HIGH?
NO
A
YES
CHECK LOGIC LEVEL AT U17C, PIN 8
IS LOGIC LEVEL HIGH?
NO
YES
CHECK LOGIC LEVEL AT U17C, PIN 10
IS LOGIC LEVEL HIGH?
NO
B
YES
U17C OR WIRING
CHECK VOLTAGE AT U21B, PIN 7
IS VOLTAGE ZERO?
NO
U20B OR WIRING
YES
U21A, U20A, U15, OR WIRING
CHECK LOGIC LEVEL AT U5C, PIN 5
IS LOGIC LEVEL LOW?
YES
NO
CHECK VOLTAGE AT TP7
IS VOLTAGE ZERO?
YES
U25A Q9, OR WIRING
NO
R39
CHECK LOGIC LEVEL AT U10E, PIN 10
IS LOGIC LEVEL HIGH?
NO
U10E, U24A, U2A, OR WIR-ING
YES
U21, U20 OR WIRING
CHECK LOGIC LEVEL AT U5B, PIN 3
IS LOGIC LEVEL HIGH?
NO
YES
CHECK LOGIC LEVEL AT U17C, PIN 8
IS LOGIC LEVEL HIGH?
NO
U24, U5, Q9 OR WIRING
YES
CHECK LOGIC LEVEL AT U10E, PIN 10
IS LOGIC LEVEL LOW?
NO
OR WIRING
YES
OR WIRING
CHECK VOLTAGE AT TP6
NO
R31
YES
OR WIRING

Figure 7-35. Error Code 21 Troubleshooting Flowchart (Sheet 1 of 2)

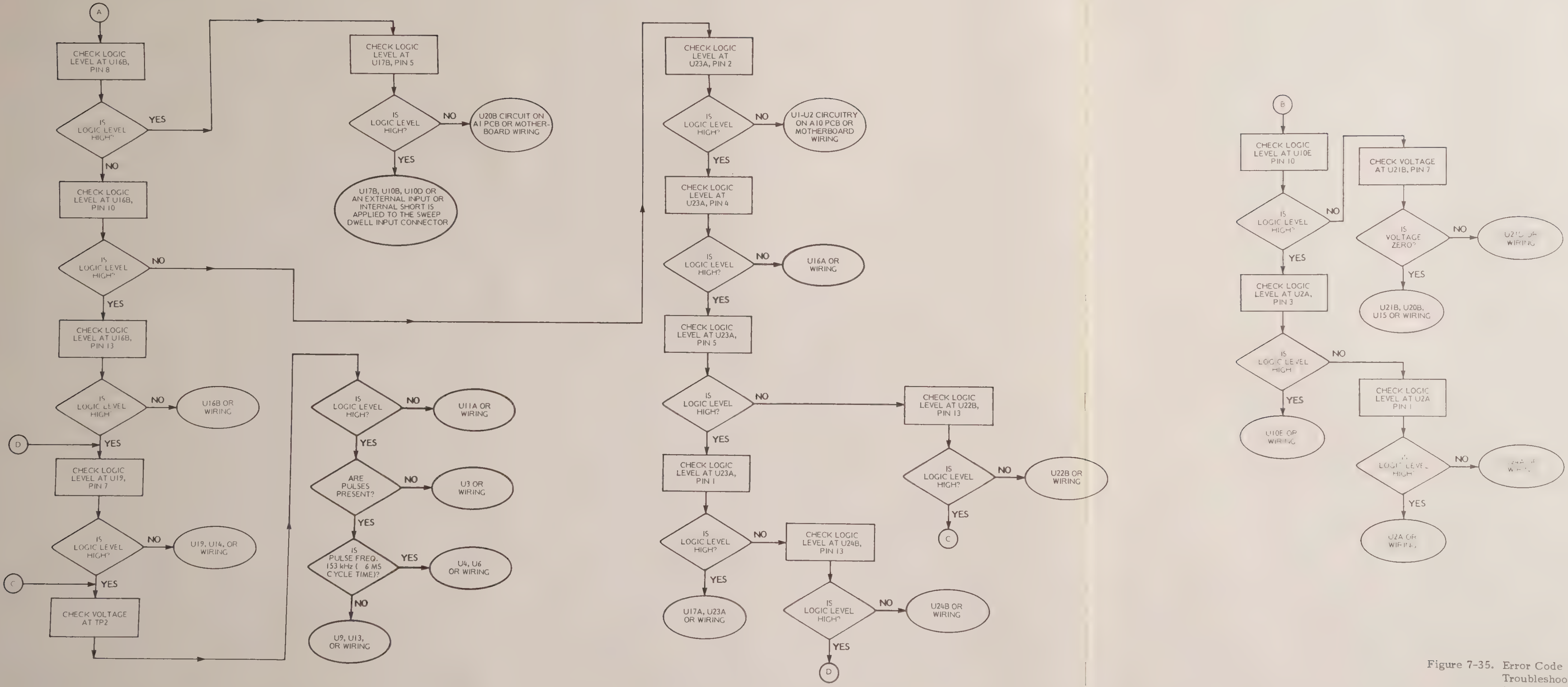

A
CHECK LOGIC LEVEL AT U16B, PIN 8
IS LOGIC LEVEL HIGH?
YES
NO
CHECK LOGIC LEVEL AT U16B, PIN 10
IS LOGIC LEVEL HIGH?
NO
YES
CHECK LOGIC LEVEL AT U16B, PIN 13
IS LOGIC LEVEL HIGH
NO
U16B OR WIRING
D
YES
CHECK LOGIC LEVEL AT U19, PIN 7
IS LOGIC LEVEL HIGH?
NO
U19, U14, OR WIRING
C
YES
CHECK VOLTAGE AT TP2
CHECK LOGIC LEVEL AT U17B, PIN 5
IS LOGIC LEVEL HIGH?
NO
U20B CIRCUIT ON A1 PCB OR MOTHER-BOARD WIRING
YES
U17B, U10B, U10D OR AN EXTERNAL INPUT OR INTERNAL SHORT IS APPLIED TO THE SWEEP DWELL INPUT CONNECTOR
IS LOGIC LEVEL HIGH?
NO
U11A OR WIRING
YES
ARE PULSES PRESENT?
NO
U3 OR WIRING
YES
IS PULSE FREQ. 153 kHz (6 MS CYCLE TIME)?
YES
U4, U6 OR WIRING
NO
U9, U13, OR WIRING
CHECK LOGIC LEVEL AT U23A, PIN 2
IS LOGIC LEVEL HIGH?
NO
U1-U2 CIRCUITRY ON A10 PCB OR MOTHERBOARD WIRING
YES
CHECK LOGIC LEVEL AT U23A, PIN 4
IS LOGIC LEVEL HIGH?
NO
U16A OR WIRING
YES
CHECK LOGIC LEVEL AT U23A, PIN 5
IS LOGIC LEVEL HIGH?
NO
YES
CHECK LOGIC LEVEL AT U22B, PIN 13
IS LOGIC LEVEL HIGH?
NO
U22B OR WIRING
YES
C
CHECK LOGIC LEVEL AT U23A, PIN 1
IS LOGIC LEVEL HIGH?
NO
YES
U17A, U23A OR WIRING
CHECK LOGIC LEVEL AT U24B, PIN 13
IS LOGIC LEVEL HIGH?
NO
U24B OR WIRING
YES
D
B
CHECK LOGIC LEVEL AT U10E PIN 10
IS LOGIC LEVEL HIGH?
NO
YES
CHECK VOLTAGE AT U21B, PIN 7
IS VOLTAGE ZERO?
NO
U21C OR WIRING
YES
U21B, U20B, U15 OR WIRING
CHECK LOGIC LEVEL AT U2A, PIN 3
IS LOGIC LEVEL HIGH
NO
YES
U10E OR WIRING
CHECK LOGIC LEVEL AT U2A PIN 1
IS LOGIC LEVEL HIGH
NO
U24A OR WIRING
YES
U2A OR WIRING

Figure 7-35. Error Code 21 Troubleshooting Flowchart (Sheet 2 of 2)

Figure 7-35(A).

7-10 A3 MARKER GENERATOR PCB

7-10.1 A3 Marker Generator PCB, Circuit Description

The A3 Marker Generator PCB generates the RF, Video, and Intensity markers. In addition, the PCB also contains the logic circuitry associated with the front panel INCREASE/DECREASE lever. A functional diagram of the marker generator circuitry is shown in Figure 7-36, and a similar diagram for the INCREASE/DECREASE lever logic circuitry is shown in Figure 7-37. The A3 PCB schematic diagram (4 sheets) is contained in Figure 7-38, and the circuits are described below.

a. Marker Generator Circuits. As shown in Figure 7-36, the inputs to the Marker Generator are a 0-10V sweep ramp from the A5 PCB and the retrace blanking control line from the A2 PCB, plus the data bus and several control lines from the A12 PCB. The 0-10V sweep ramp (**RAMP, 0-10V**) may be either the **RAMP OUT** signal from the A2 PCB, the **MAN SWEEP INPUT** from the front panel, or the Step Freq DAC signal (paragraph 3-7.2) from the A5 PCB. The inputs from the A12 PCB are as follows:

   1. three marker-frequency (F0, M1, M2), 8-bit digital groups
   2. a 3-bit marker mode and a 3-bit marker-frequency-disable control group
   3. four latch-clock control bits (SP9, SP10, SP11, SP12)
   4. three marker-identify control bits.

   The three marker-frequency digital groups represent either the preset marker frequencies (paragraph 3-2.7) or the marker frequencies selected using the front panel controls (paragraph 3-2.4).

   The three digital groups provide the inputs for the three digital-to-analog converter circuits (DACs) (U5-U8A, U6-U9A, U7-U10A). These DAC circuits have built-in latches. When the microprocessor clocks these DAC latches HIGH, the marker-frequency words are loaded and subsequently converted to discrete voltages between 0 and 10 volts. These voltages represent the marker's relative position within the band of frequencies being swept. For example, 3 volts would indicate that the marker frequency is located approximately 1/3 of the way between the low and high ends of the band; 5 volts would indicate that the marker frequency is located in the middle of the band; and 10 volts would indicate that the marker frequency is located at the high end of the band. These marker-frequency voltages are applied to the Marker Comparator circuits.

   The Marker Comparator circuits (U8D, U9D, U10D) effectively compare the marker-frequency voltages with the **RAMP, 0-10V** signal. The output of each comparator is a steeply sloping ramp with voltage excursions between -13.5 and +13.5 volts. The midpoints (0V) on these ramps are the comparison points, that is, the points at which the instantaneous voltages of the sweep ramps equal the marker-frequency voltages from the DACs. The **F0, M1,** and **M2** ramps are applied to the Absolute Value circuits.

   The Absolute Value circuits (U10C, U9B, U10B) change the **F0, M1,** and **M2** ramps into triangular waveforms, the apexes of which represent the respective marker's location. The usable portion of these waveforms, after being offset, varies between 0 and +5 volts. The 0-5V signals are applied to the marker output circuits, via the marker-frequency disable logic circuits (Q4, Q5, Q6).

   The marker-frequency-disable logic circuits are controlled respectively by the **H F0 DISABLE, H M1 DISABLE,** and **H M2 DISABLE** control lines. These control lines come from the Marker Select and Control latch and logic circuits (U1, U2D, U2C, U2B). If the microprocessor disables a marker or if a marker-frequency front panel pushbutton (F0, M1, M2) is pressed, the respective marker-disable control line is set TRUE (high). When TRUE, these lines cause their respective marker's Absolute Value circuit output to be shunted to ground.

The 0-5V signals from the Absolute Value circuits are applied, via the MARKER AMPLITUDE control to the RF and Video Marker Output circuits. The control inputs to these output circuits are the **H RF MARKER ENABLE** and the **H VIDEO MARKER ENABLE** lines from the Mode Enable Logic circuits (U11C, U11D). If the MARKERS - RF pushbutton is engaged and a forward frequency sweep is in progress (**L RETRACE BLANKING** is FALSE), the **H RF MARKER ENABLE** line will be TRUE. When this line is TRUE, the output of the RF Marker Output circuit (U8B) will be a 0-5V analog signal. The actual amplitude of this signal will depend on the MARKER AMPLITUDE control setting. This 0-5V signal is applied to the A4 Automatic Level Control PCB, where it causes a "dip" in the RF output power level. If the MARKERS - VIDEO pushbutton is engaged, the Video Marker Output circuit (U9C) operation is the same as described for RF. The output of the video marker circuit is applied to the rear panel MARKER OUTPUT connector.

The 0-5V signals from the Absolute Value circuits are also applied directly to the Intensity Marker Output circuit (U12). The operation of the Intensity Marker Output circuit is similar to that described for the RF marker circuit, above. If MARKERS - INTENSITY is engaged and a forward sweep is in progress, the output of the intensity marker circuit will go HIGH when a marker is encountered. This HIGH is applied to the A2 Ramp Generator PCB, where it causes the A2-generated sweep ramp to dwell.

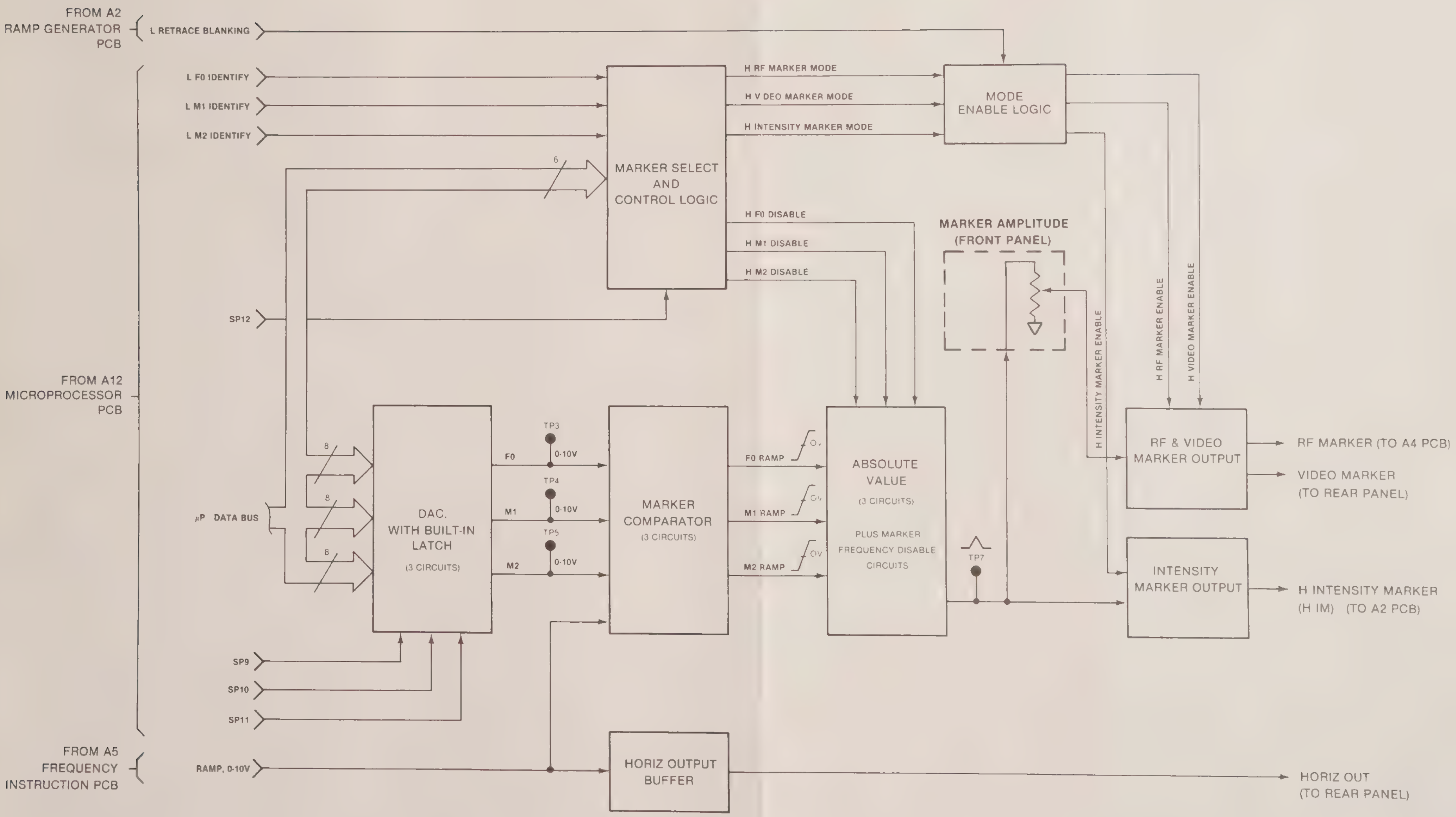

FROM A2
RAMP GENERATOR
PCB
L RETRACE BLANKING
L F0 IDENTIFY
L M1 IDENTIFY
L M2 IDENTIFY
6
MARKER SELECT
AND
CONTROL LOGIC
H RF MARKER MODE
H VIDEO MARKER MODE
H INTENSITY MARKER MODE
MODE
ENABLE LOGIC
H F0 DISABLE
H M1 DISABLE
H M2 DISABLE
MARKER AMPLITUDE
(FRONT PANEL)
H INTENSITY MARKER ENABLE
H RF MARKER ENABLE
H VIDEO MARKER ENABLE
SP12
FROM A12
MICROPROCESSOR
PCB
µP DATA BUS
8
8
8
DAC.
WITH BUILT-IN
LATCH
(3 CIRCUITS)
TP3
TP4
TP5
F0
M1
M2
0-10V
0-10V
0-10V
MARKER
COMPARATOR
(3 CIRCUITS)
F0 RAMP
M1 RAMP
M2 RAMP
0V
0V
0V
ABSOLUTE
VALUE
(3 CIRCUITS)
PLUS MARKER
FREQUENCY DISABLE
CIRCUITS
TP7
RF & VIDEO
MARKER OUTPUT
RF MARKER (TO A4 PCB)
VIDEO MARKER
(TO REAR PANEL)
INTENSITY
MARKER OUTPUT
H INTENSITY MARKER
(H IM) (TO A2 PCB)
SP9
SP10
SP11
FROM A5
FREQUENCY
INSTRUCTION PCB
RAMP, 0-10V
HORIZ OUTPUT
BUFFER
HORIZ OUT
(TO REAR PANEL)

Figure 7-36. A3 PCB Marker Generator Functional Block Diagram

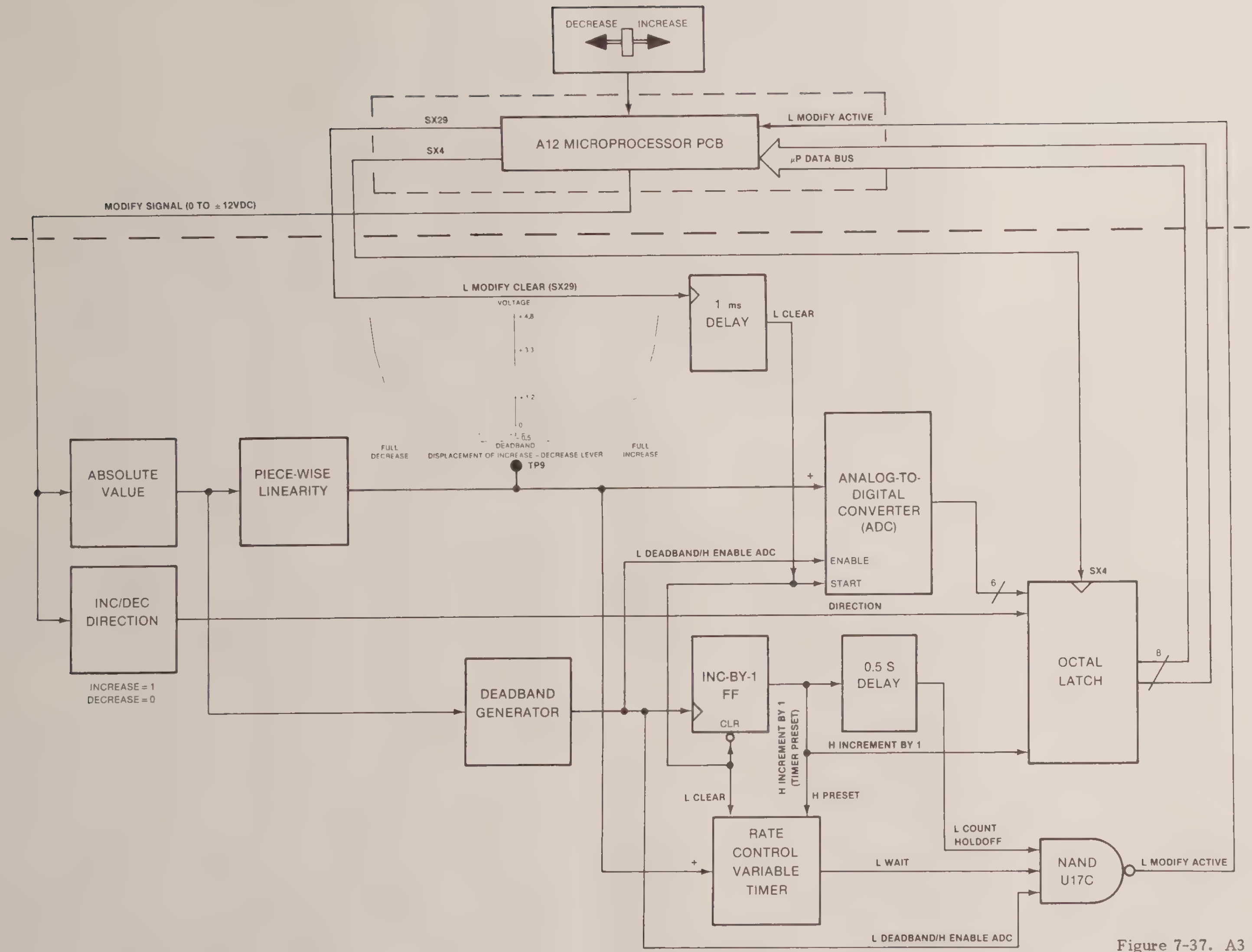

DECREASE
INCREASE
A12 MICROPROCESSOR PCB
SX29
SX4
L MODIFY ACTIVE
μP DATA BUS
MODIFY SIGNAL (0 TO ±12VDC)
L MODIFY CLEAR (SX29)
VOLTAGE
FULL DECREASE
DEADBAND
DISPLACEMENT OF INCREASE - DECREASE LEVER
FULL INCREASE
TP9
1 ms DELAY
L CLEAR
ABSOLUTE VALUE
PIECE-WISE LINEARITY
ANALOG-TO-DIGITAL CONVERTER (ADC)
ENABLE
START
L DEADBAND/H ENABLE ADC
DIRECTION
6
SX4
INC/DEC DIRECTION
INCREASE = 1
DECREASE = 0
OCTAL LATCH
8
DEADBAND GENERATOR
INC-BY-1 FF
CLR
0.5 S DELAY
H INCREMENT BY 1 (TIMER PRESET)
H INCREMENT BY 1
L CLEAR
H PRESET
L COUNT HOLDOFF
RATE CONTROL VARIABLE TIMER
L WAIT
NAND U17C
L MODIFY ACTIVE
L DEADBAND/H ENABLE ADC

Figure 7-37. A3 PCB INCREASE/DECREASE Logic Circuit Functional Block Diagram

b. INCREASE/DECREASE Lever Logic Circuitry. This circuitry performs two distinct functions, as follows:

1. When the INCREASE/DECREASE lever is "tapped," the circuit causes the microprocessor to increase or decrease the value of the selected parameter (paragraph 3-2.1a) in one-increment steps.
2. When the INCREASE/DECREASE lever is moved to either side from center, the circuit causes the microprocessor to increase or decrease the value of the selected parameter at a variable rate. This rate depends upon lever displacement.

The first function the circuit performs is to increase or decrease the selected parameter's value in one-increment steps. As shown in Figure 7-37, the INCREASE/DECREASE lever logic circuitry is connected in a control loop with the A12 Microprocessor PCB. The INCREASE/DECREASE lever itself is connected to the A12 PCB. This lever controls, via circuitry on the A12 PCB, the voltage level of the **MODIFY SIGNAL** input line to the A3 PCB. When the lever is moved from its center position, the **MODIFY SIGNAL** line's voltage value is between either 0 and -12 Vdc or 0 and +12 Vdc. The voltage's polarity and value depend on the direction and length of INCREASE/DECREASE lever displacement. Displacement in the DECREASE direction yields a positive voltage, and displacement in the INCREASE direction yields a negative voltage. This 0 to ±12 Vdc voltage goes to two places on the A3 PCB: the Absolute Value and the Inc/Dec Direction circuits.

At the Inc/Dec Direction circuit (U14B, Q2), the 0 to ±12 Vdc signal is translated into either a logic 1 or a logic 0, depending upon the voltage's polarity. If its polarity is negative, the logic level is a 1; if positive, the logic level is a 0. The output of this circuit (**DIRECTION** signal line) is applied to the Octal Latch (U19), where it waits to be clocked out to the microprocessor.

At the Absolute Value circuit (U13A), the 0 to ±12 Vdc signal is changed to a positive voltage when the INCREASE/DECREASE lever is moved either direction from center. (The circuit-output voltage is slightly negative when the lever is at its center (rest) position.) One portion of this signal goes to the Piece-Wise Linearity circuit; the other goes to the Deadband Generator circuit.

The purpose of the Deadband Generator circuit (U14A, Q1) is to keep the logic circuitry inactive when the INCREASE/DECREASE lever is in its center position. When the lever is moved from center, the positive output of the Absolute Value circuit causes the **L DEADBAND/H ENABLE ADC** control line to go HIGH. This control line serves the following purposes:

- When the **L DEADBAND/H ENABLE ADC** line transitions from LOW to HIGH, it clocks the **H INCREMENT BY 1 (TIMER PRESET)** control line HIGH. When HIGH, this line presets the Rate Control Variable Timer circuit (U13B, U14D, U14C, Q3), which sets the **L WAIT** control line HIGH. Also, the HIGH state of the **H INCREMENT BY 1** control line provides the logic input for the most-significant bit (MSB) of the Octal Latch.
- When the **L DEADBAND/H ENABLE ADC** line goes HIGH, it provides an enabling logic level to the Analog-to-Digital Converter (ADC) circuit (U18, U17A, U17B); it also enables one "leg" of NAND gate U17C.

The U17C NAND gate has three inputs: **L WAIT**, **L DEADBAND/H ENABLE ADC**, and **L COUNT HOLDOFF**. As already described, the first two inputs have been set HIGH; the third input, **L COUNT HOLDOFF**, is normally HIGH. Now, with all three U17C inputs HIGH, the **L MODIFY ACTIVE** line goes LOW (true). When the microprocessor senses that **L**

Figure 7-37

MODIFY ACTIVE is LOW, it uses **SX4** to clock the Octal Latch. When clocked, the Octal Latch outputs an 8-bit digital word. If the MSB of this word is a 1, the microprocessor increases or decreases (depending on the **DIRECTION** bit) the selected parameter by 1 increment. After performing this incremental function, the microprocessor uses **SX29** to clear the logic circuitry by clocking the 1 ms Delay circuit.

The 1 ms Delay circuit (U16B) generates the 1 ms **L CLEAR** pulse. This pulse goes several places. At the ADC circuit, the **L CLEAR** pulse is inverted and then ANDed with the L **DEADBAND/H ENABLE ADC** logic level. The signal resulting from this ANDing process starts the ADC voltage-conversion cycle. Once a conversion is done, U18 pin 5 goes LOW and triggers another conversion cycle. This repetitive triggering process keeps the ADC free-running as long as the **L DEADBAND/H ENABLE ADC** line stays HIGH. And this line will stay HIGH until the INCREASE/DECREASE lever is returned to its center position.

In addition to getting an ADC conversion started, the **L CLEAR** pulse has two other functions: it resets the Inc-by-1 FF, and it clears the Rate Control Variable Timer circuit.

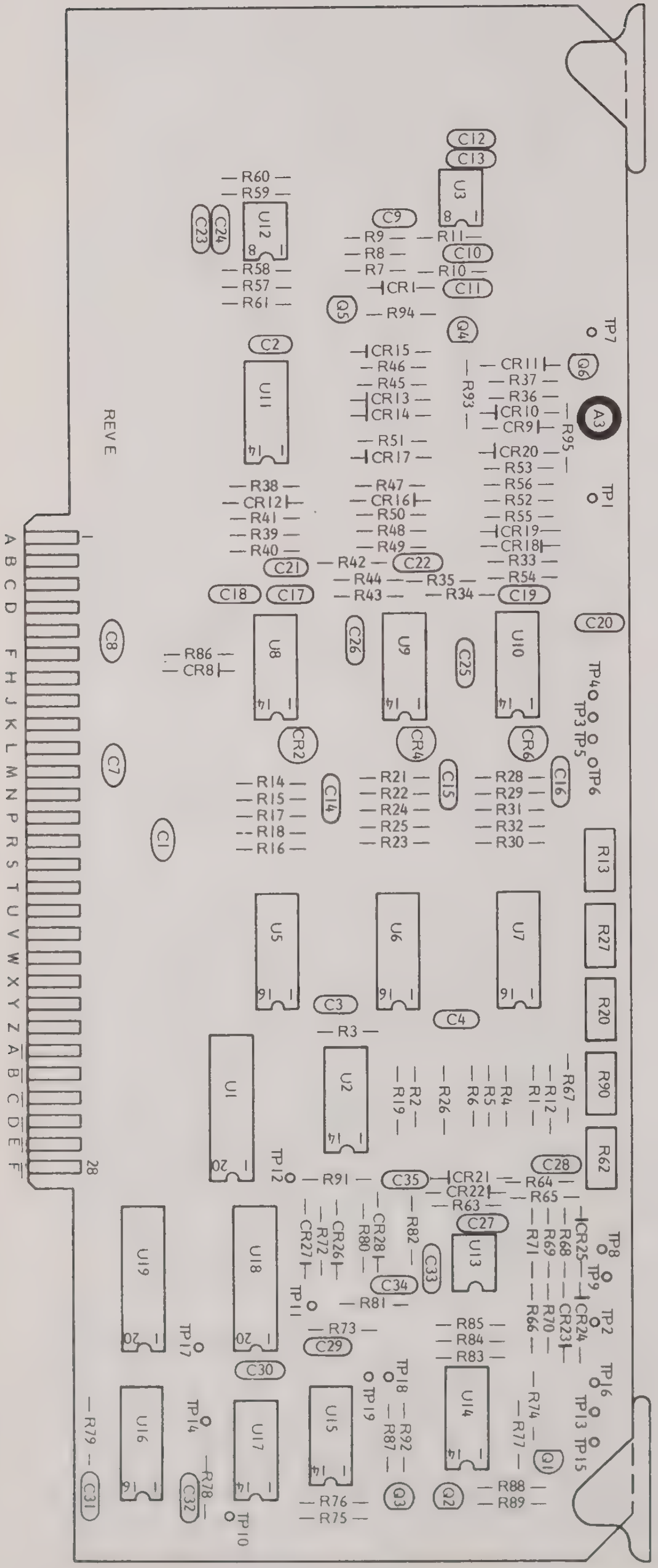
When reset, the HIGH-to-LOW transition of the Inc-By-1 FF Q-output clocks the **L COUNT HOLDOFF** control line TRUE. The TRUE state of this line causes the **L MODIFY ACTIVE** line to go FALSE and stay that way for about 0.5 seconds.

When cleared, the Rate Control Variable Timer circuit returns the **L WAIT** control line to its TRUE state. The increment-by-1 function is thus completed. Now, if the INCREASE/DECREASE lever has been moved and held rather than just "tapped," the circuit is primed for its second (variable rate) function.

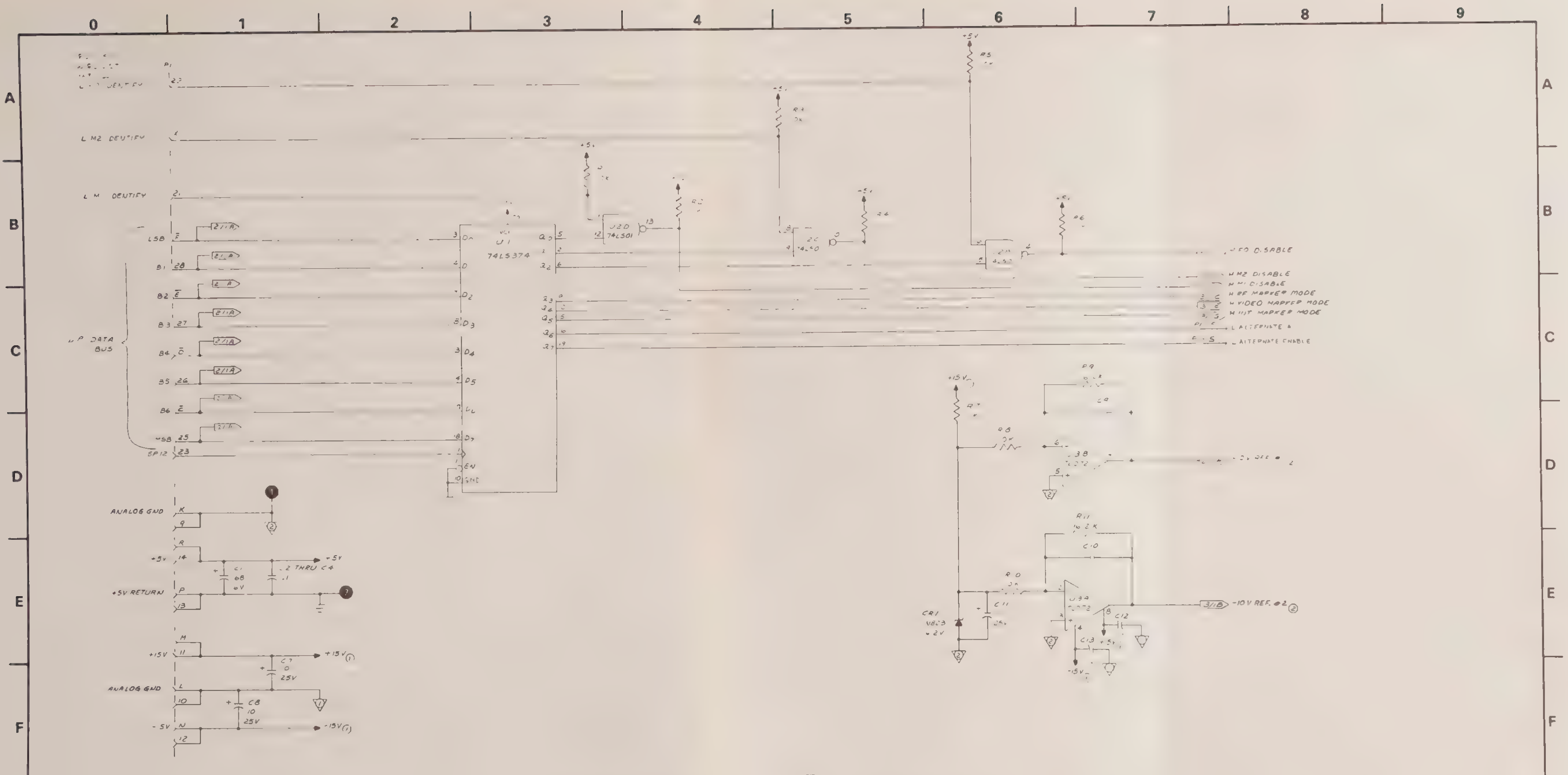
To begin the discussion of the second function, go back to the Absolute Value circuit. As mentioned earlier, a portion of this circuit's output voltage goes to the Piece-Wise Linearity circuit (R70, CR24-CR25-R69, CR23-R68, R71). This circuit is a three-piece voltage divider. The circuit provides the velocity breakpoints that can be observed as the lever is moved. These breakpoints (+1.2, +3.3, and +4.8 volts) are shown in the voltage/lever-displacement diagram above TP9. Although not drawn to scale horizontally, this diagram suggests the relationship that exists between the displacement of the lever and the speed with which the selected parameter increases or decreases.

The voltage at TP9 provides both the input for the ADC circuit, and the input for the Rate Control Variable Timer circuit.

The purpose of the Rate Control Variable Timer circuit is to slow down the count when the INCREASE/DECREASE lever is moved by only a small amount. The timer circuit uses a voltage-integrator RC (resistor-capacitor) network to form a timing ramp. When the velocity voltage at TP9 is low, the RC network capacitor takes a long time to charge; hence, the circuit produces a long time-delay. As the voltage at TP9 increases, the capacitor charges more quickly and the timer-circuit delay time becomes shorter.


REVE
A B C D F H J K L M N P R S T U V W X Y Z A̅ B̅ C̅ D̅ E̅ F̅
1
28
A3
U1
U2
U3
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
U19
Q1
Q2
Q3
Q4
Q5
Q6
C1
C2
C3
C4
C7
C8
C9
C10
C11
C12
C13
C14
C15
C16
C17
C18
C19
C20
C21
C22
C23
C24
C25
C26
C27
C28
C29
C30
C31
C32
C33
C34
C35
CR1
CR2
CR4
CR6
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
CR19
CR20
CR21
CR22
CR23
CR24
CR25
CR26
CR27
CR28
R13
R27
R20
R90
R62
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
TP12
TP13
TP14
TP15
TP16
TP17
TP18
TP19

A3 PCB Parts Locator Diagram


P1
L M2 DENTIFY
L M DENTIFY
LSB
B1
B2
B3
B4
B5
B6
MSB
μP DATA BUS
SP12
2/1A
U1
74LS374
D0
D1
D2
D3
D4
D5
D6
D7
EN
GND
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
+5V
U20
74LS01
R2
R3
R4
R5
R6
U20
74LS00
L RFO DISABLE
H MZ DISABLE
H M1 DISABLE
H RF MARKER MODE
H VIDEO MARKER MODE
H IIT MARKER MODE
L ALTERNATE A
L ALTERNATE ENABLE
ANALOG GND
K
9
R
14
+5V RETURN
P
13
C1
68
6V
C2 THRU C4
.1
+15V
M
11
C7
10
25V
L
10
C8
10
25V
-15V
N
12
+15V
R7
R8
R9
C9
U3B
TL072
R10
R11
10.2K
C10
C11
25V
CR1
VR23
6.2V
U3A
TL072
C12
C13
3/1B
-10V REF. #2

REFERENCE DESIGNATORS	
LAST USED	NOT USED
35	4
CR28	58
P	5, C6
Q	R357
R95	
TP	
U19	

NOTES.

1. UNLESS OTHERWISE NOTED, RESISTANCES ARE IN OHMS AND CAPACITANCES IN MICROFARADS
2. ◠ DENOTES SCREWDRIVER-ADJUST CONTROL.
3. ⓱ DENOTES TEST POINT.
4. 2/1D MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
5. ━━━ DENOTES PRIMARY SIGNAL PATH
6. ╍╍╍ DENOTES FEEDBACK SIGNAL PATH
7. UNLESS OTHERWISE NOTES ALL DIODES ARE 1N4446
8. ⏚ DENOTES +5V RETURN.
9. ▽① DENOTES ANALOG GROUND 1, AND -V① DENOTES RELATIVE VOLTAGES
10. ▽② DENOTES ANALOG GROUND 2, AND -V② DENOTES RELATIVE VOLTAGES.

Figure 7-38. A3 Marker Generator PCB Schematic (Sheet 1 of 4)

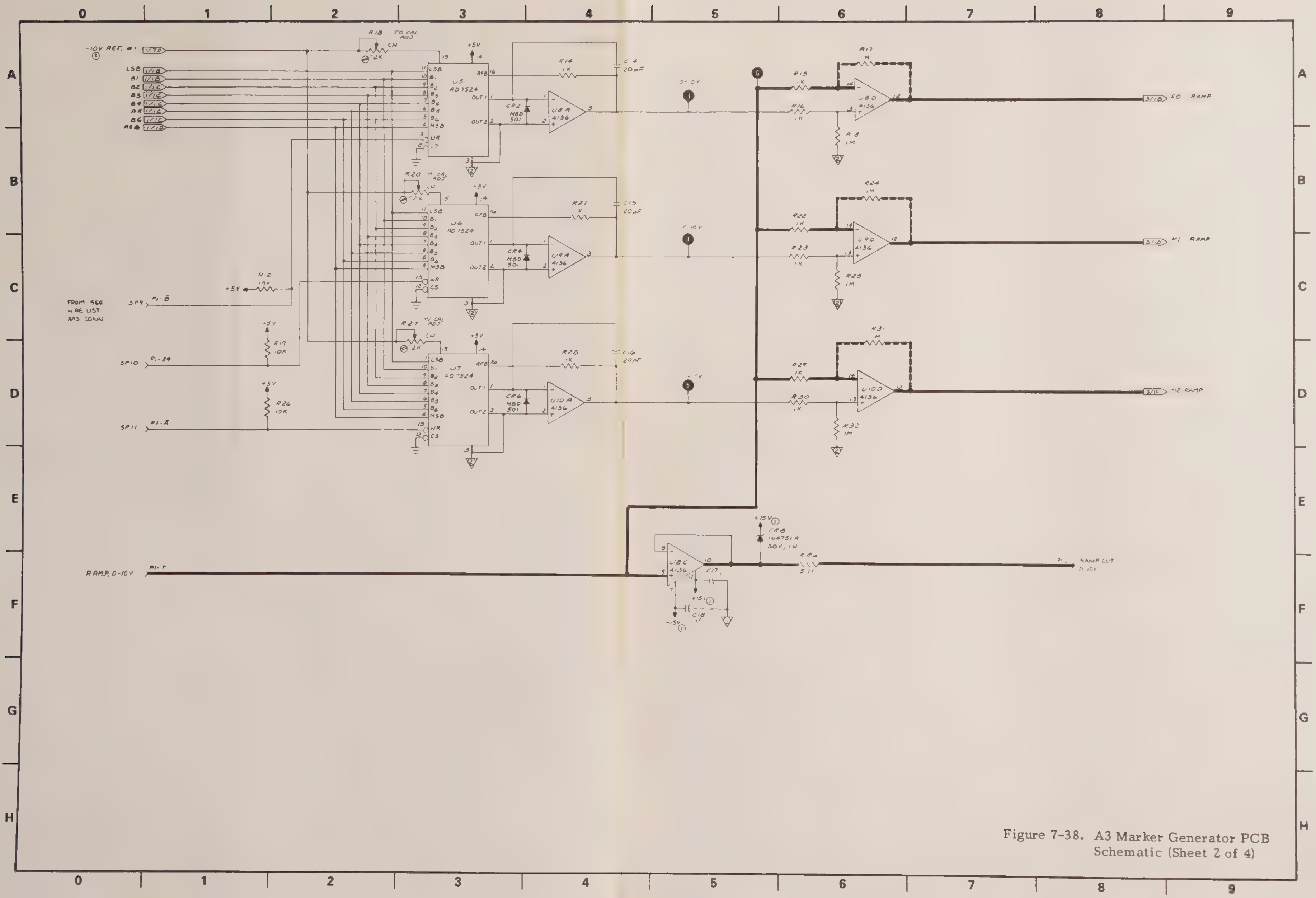
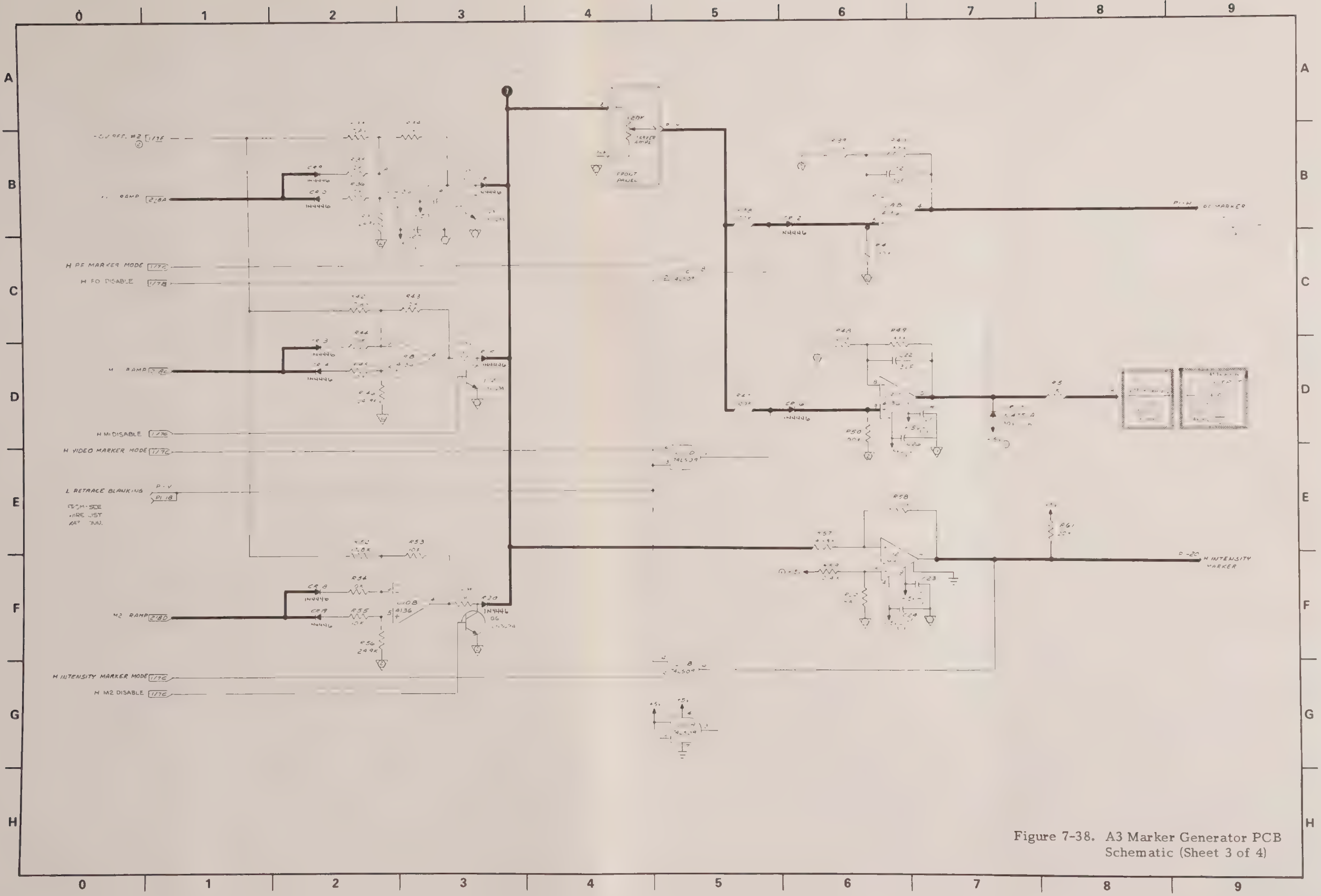

-10V REF. #1
LSB
B1
B2
B3
B4
B5
B6
MSB
R18 FO CAL ADJ
2K
CW
+5V
U5 AD7524
RFB
OUT 1
OUT 2
WR
CS
R14 1K
C14 20pF
CR2 MBD 501
U8A 4136
0-0V
R15 1K
R16 1K
R17 1M
U8D 4136
R8 1M
FO RAMP
R20 M1 CAL ADJ
U6 AD7524
R21 1K
C15 20pF
CR4 MBD 501
U9A 4136
R22 1K
R23 1K
R24 1M
U9D 4136
R25 1M
M1 RAMP
R12 10K
FROM SEE WIRE LIST XA3 CONN
SP9
P1-B
SP10
P1-24
R19 10K
R27 M2 CAL ADJ
U7 AD7524
R28 1K
C16 20pF
CR6 MBD 501
U10A 4136
R29 1K
R30 1K
R31 1M
U10D 4136
R32 1M
M2 RAMP
SP11
P1-A
R26 10K
RAMP, 0-10V
P1-T
U8C 4136
C17
C18 .1
+15V
-15V
CR8 1N4751A 30V, 1W
R36 511
RAMP OUT 0-10V
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H

Figure 7-38. A3 Marker Generator PCB Schematic (Sheet 2 of 4)



H PF MARKER MODE 1/7C
H FO DISABLE 1/7B
RAMP 2/8A
RAMP 2/8C
M2 RAMP 2/8D
H MI DISABLE 1/7C
H VIDEO MARKER MODE 1/7C
L RETRACE BLANKING
P1-V
P1 18
H INTENSITY MARKER MODE 1/7C
H M2 DISABLE 1/7C
CR9
CR10
CR13
CR14
CR18
CR19
CR20
1N4446
R43
R44
R46
R53
R54
R55
R56
24.9K
10K
4136
Q6
FRONT PANEL
MARKER AMPL
R48
R49
C22
R50
R57
R58
R61
C23
C24
CR12
CR16
74LS09
P1-W
PF MARKER
P-20
H INTENSITY MARKER
+5V
-5V
A
B
C
D
E
F
G
H
0
1
2
3
4
5
6
7
8
9

Figure 7-38. A3 Marker Generator PCB Schematic (Sheet 3 of 4)

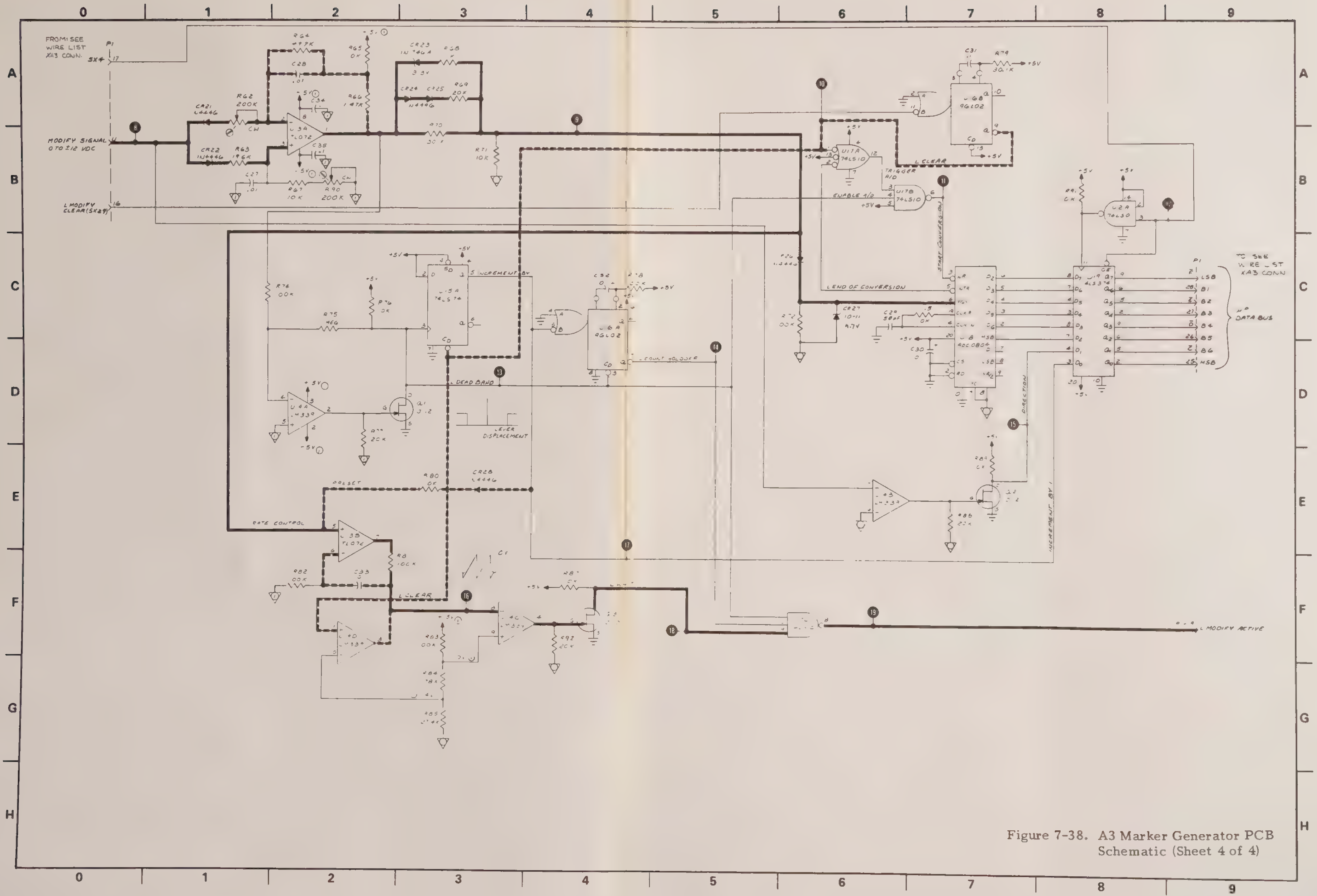

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
FROM SEE WIRE LIST XA3 CONN.
P1
SX4
MODIFY SIGNAL 0 TO ±12 VDC
L MODIFY CLEAR (SX29)
CR21 1N4446
CR22 1N4446
R62 200K
R63 196K
R64 147K
C28 .01
R65
R66 147K
U9A TL072
C34
C35
C27 .01
R67 10K
R90 200K
CW
CR23 1N4446
CR24
CR25
R68
R69 20K
R70 30K
R71 10K
U17A 74LS10
U17B 74LS10
U6B 96L02
C31
R79 30.1K
+5V
-5V
L CLEAR
TRIGGER A/D
ENABLE A/D
START CONVERSION
L END OF CONVERSION
CR26 1N4446
CR27
C29 58pF
C30
U8 ADC0804
U19 74LS374
U2A 74LS30
TO SEE WIRE LIST XA3 CONN
LSB
B1
B2
B3
B4
B5
B6
MSB
µP DATA BUS
R74 100K
R75 1MEG
R76
U15A 74LS74
INCREMENT BY 5
U6A 96L02
C32
R78
COUNT HOLDOFF
DEAD BAND
U4A LM339
Q1 J112
LEVER DISPLACEMENT
DIRECTION
INCREMENT BY 1
Q2 J112
R85 20K
PRESET
R80
CR28 1N4446
RATE CONTROL
U3B TL072
R82
C33
L CLEAR
U4D LM339
U4C LM339
R83
R84
R85
R92 20K
Q3
L MODIFY ACTIVE
8
9
10
11
12
13
14
15
16
17
18
19

Figure 7-38. A3 Marker Generator PCB Schematic (Sheet 4 of 4)

7-10.2 A3 Marker Generator PCB, Troubleshooting Information and Data

Error Code 22 reports on the status of the A3 Marker Generator PCB. The microprocessor routine associated with this error code performs the A3 PCB test in the following manner:

a. It positions the A3 marker frequencies as follows:

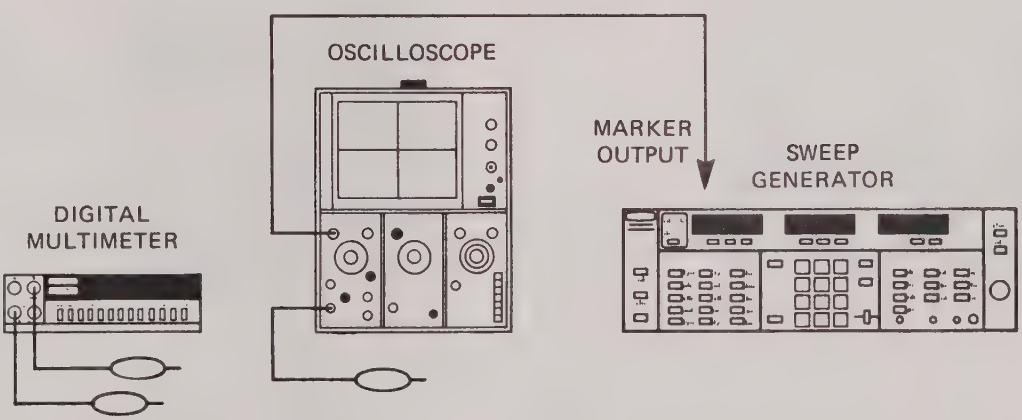
   1. M1 to a frequency point equal to 25% of the sweep width.
   2. F0 to a frequency point equal to 50% of the sweep width.
   3. M2 to a frequency point equal to 75% of the sweep width.

b. It selects the Intensity Markers on A3, the A2 Sweep Ramp on A5, and CW Filter Out on A5.

c. It sets the A2 sweep ramp for an 8 ms sweep and selects AUTO triggering.

d. It counts the markers during the forward-sweep period; if three markers are not counted, the routine causes "Error 22" to be displayed.

The test setup for troubleshooting Error Code 22 is provided in Figure 7-39, the troubleshooting flowchart is in Figure 7-40, and the troubleshooting block diagram is in Figure 7-41.

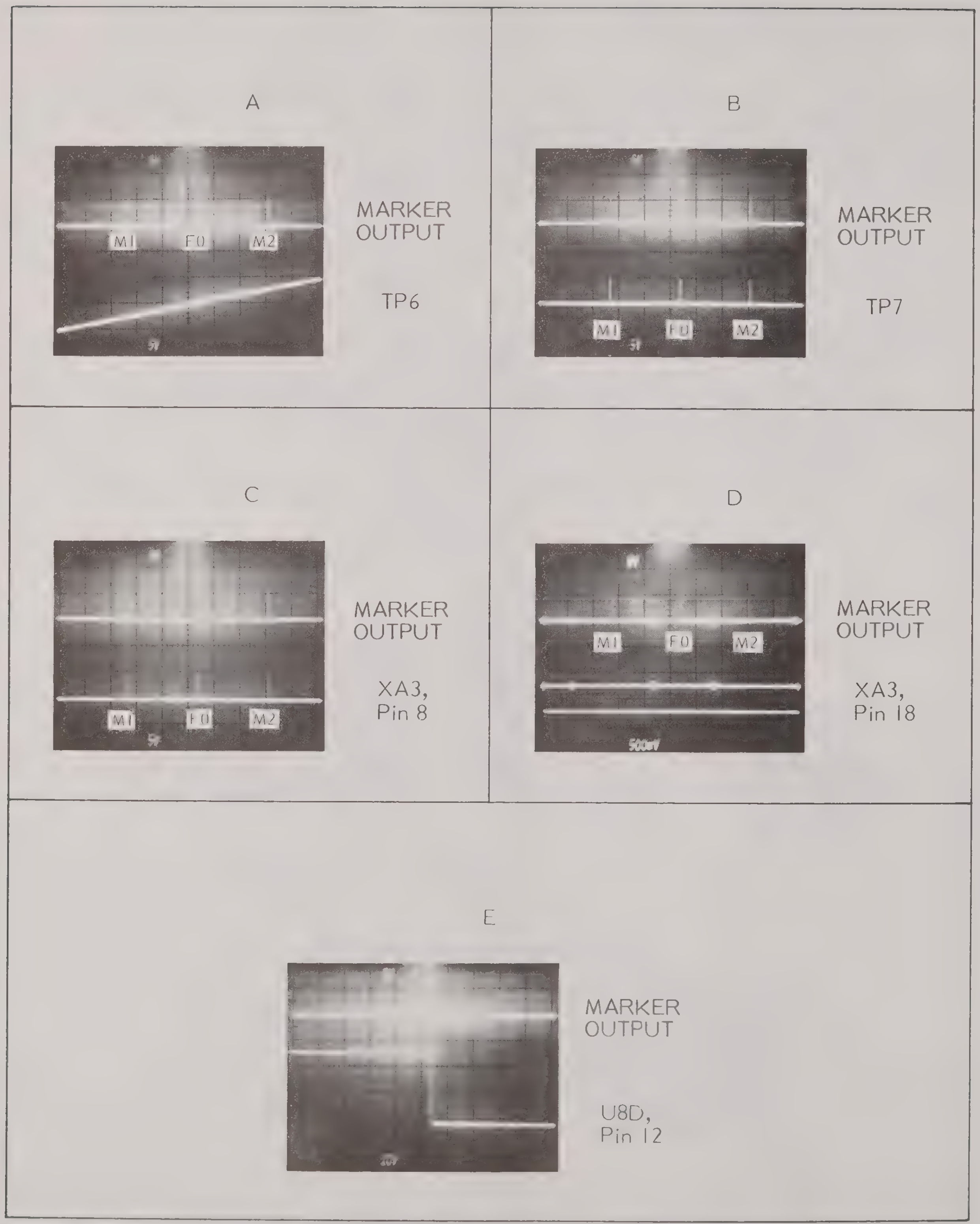


Sweep Generator Control Settings

FREQUENCY RANGE: FULL
TRIGGER: AUTO
MARKERS: VIDEO
LEVELING: INTERNAL
MARKER AMPLITUDE: Fully CW
LEVEL: 0 dBm
SWEEP TIME: 10 ms

RETRACE RF: ON
RF ON: ON
RF SLOPE: OFF
M1: 5 GHz
F0: 10 GHz
M2: 15 GHz

Figure 7-39. Test Equipment for Troubleshooting Error Code 22



A3 Marker Generator PCB Waveforms (part of Figure 7-40)

GENERAL INSTRUCTIONS

1. Check the following dc voltages before starting the flowchart:
   - a. +5V - P1, pins R(+) and P(-)
   - b. +15V - P1, pin M (reference measurement to pin L)
   - c. -15V - P1, pin N (reference measurement to pin L)
2. Logic levels are TTL.

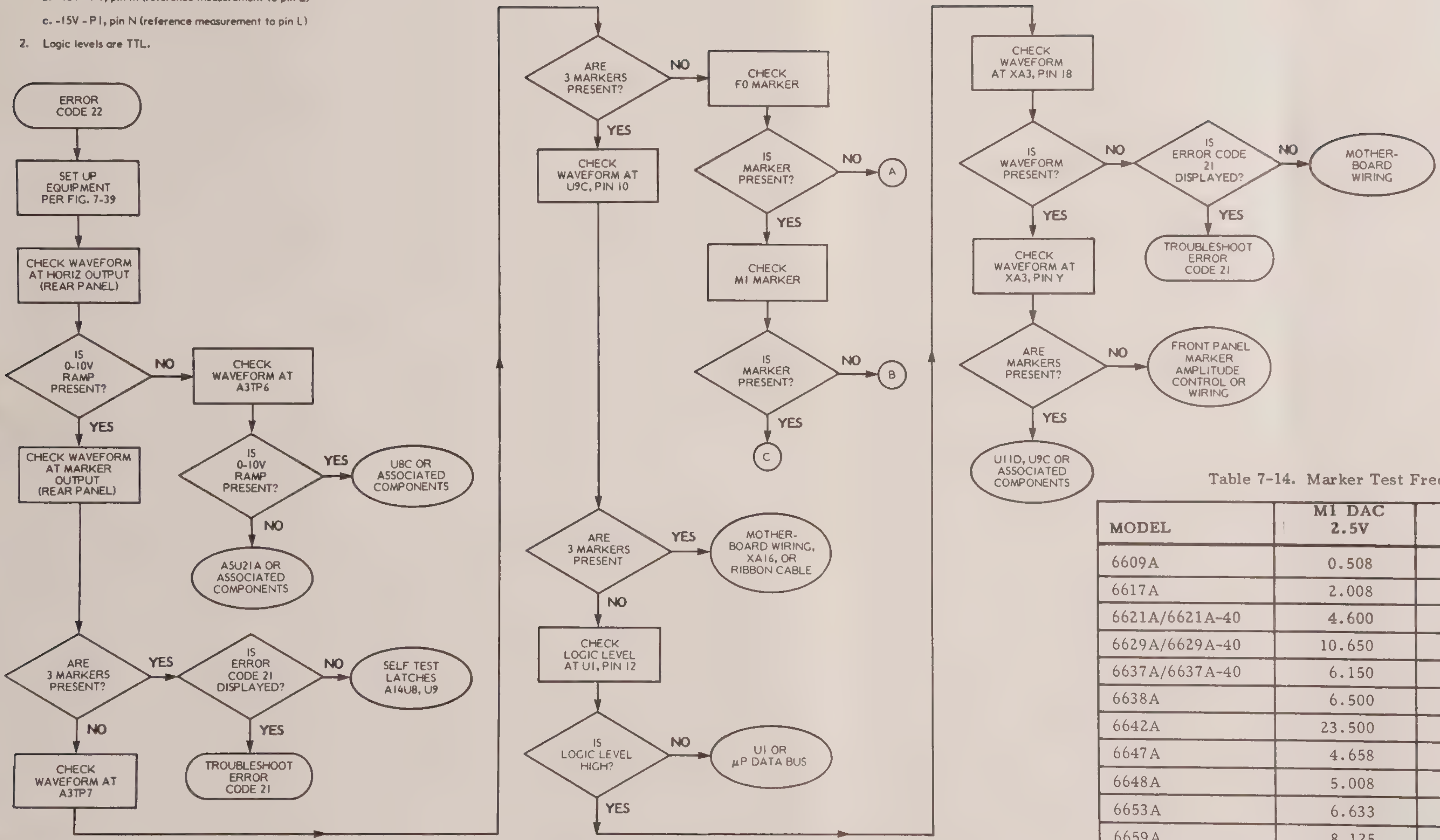

ERROR CODE 22
SET UP EQUIPMENT PER FIG. 7-39
CHECK WAVEFORM AT HORIZ OUTPUT (REAR PANEL)
IS 0-10V RAMP PRESENT?
NO
CHECK WAVEFORM AT A3TP6
IS 0-10V RAMP PRESENT?
YES
U8C OR ASSOCIATED COMPONENTS
NO
A5U21A OR ASSOCIATED COMPONENTS
YES
CHECK WAVEFORM AT MARKER OUTPUT (REAR PANEL)
ARE 3 MARKERS PRESENT?
YES
IS ERROR CODE 21 DISPLAYED?
NO
SELF TEST LATCHES A14U8, U9
YES
TROUBLESHOOT ERROR CODE 21
NO
CHECK WAVEFORM AT A3TP7
ARE 3 MARKERS PRESENT?
NO
CHECK F0 MARKER
IS MARKER PRESENT?
NO
A
YES
CHECK M1 MARKER
IS MARKER PRESENT?
NO
B
YES
C
YES
CHECK WAVEFORM AT U9C, PIN 10
ARE 3 MARKERS PRESENT
YES
MOTHER-BOARD WIRING, XA16, OR RIBBON CABLE
NO
CHECK LOGIC LEVEL AT U1, PIN 12
IS LOGIC LEVEL HIGH?
NO
U1 OR µP DATA BUS
YES
CHECK WAVEFORM AT XA3, PIN 18
IS WAVEFORM PRESENT?
NO
IS ERROR CODE 21 DISPLAYED?
NO
MOTHER-BOARD WIRING
YES
TROUBLESHOOT ERROR CODE 21
YES
CHECK WAVEFORM AT XA3, PIN Y
ARE MARKERS PRESENT?
NO
FRONT PANEL MARKER AMPLITUDE CONTROL OR WIRING
YES
U11D, U9C OR ASSOCIATED COMPONENTS

Figure 7-40. Error Code 22 Troubleshooting Flowchart (Sheet 1 of 3)

Table 7-14. Marker Test Frequencies (GHz)

MODEL	M1 DAC 2.5V	F0 DAC 5.0V	M2 DAC 7.5V
6609A	0.508	1.005	1.503
6617A	2.008	4.005	6.003
6621A/6621A-40	4.600	7.200	9.800
6629A/6629A-40	10.650	13.300	15.950
6637A/6637A-40	6.150	10.300	14.450
6638A	6.500	11.000	15.500
6642A	23.500	29.000	34.500
6647A	4.658	9.305	13.953
6648A	5.008	10.005	15.003
6653A	6.633	13.255	19.878
6659A	8.125	14.250	20.375

Formula: $V_{DAC} = 10\left(\frac{F_{Mkr} - F_{Start}}{F_{Stop} - F_{Start}}\right)$

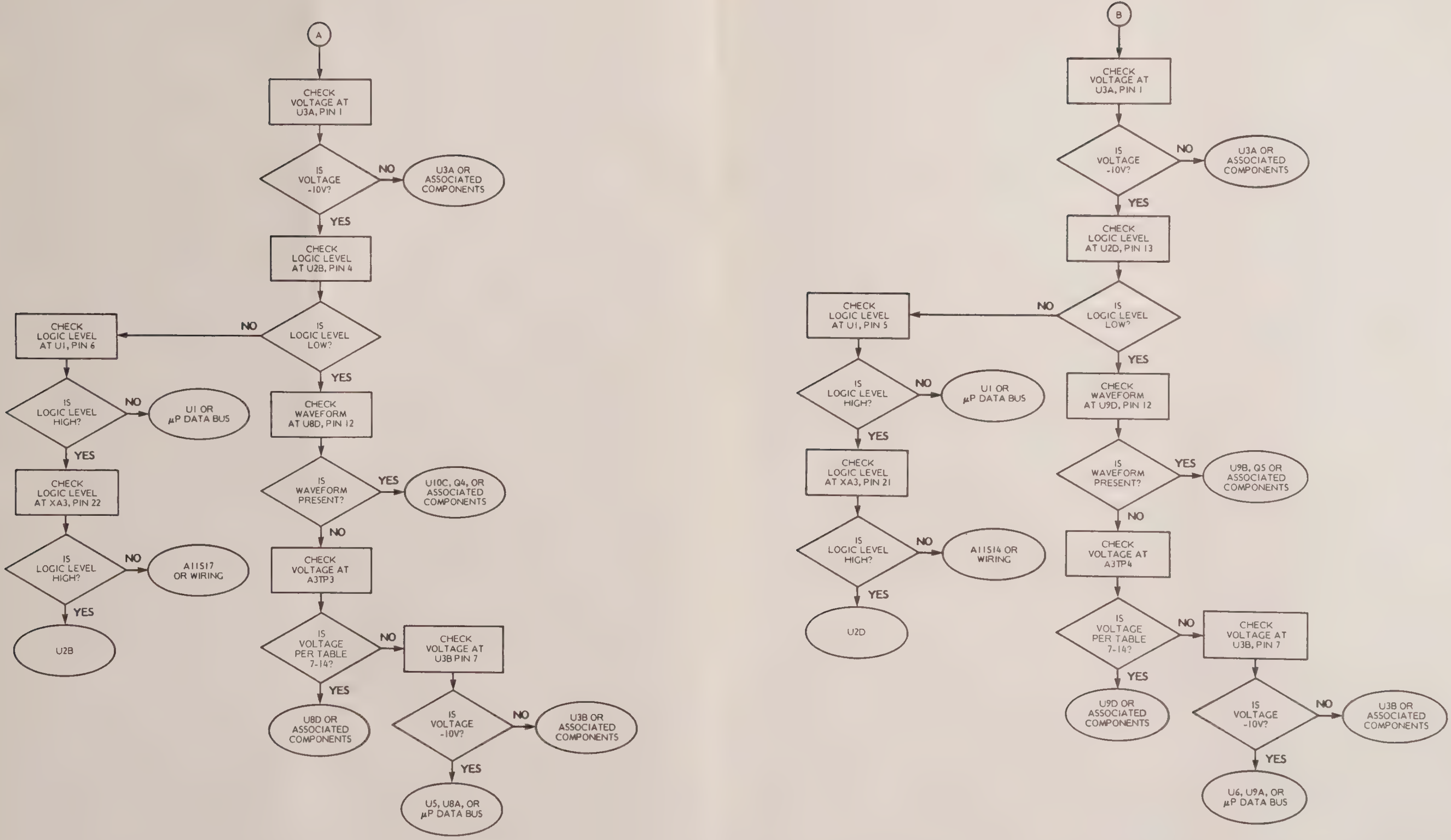

A
CHECK VOLTAGE AT U3A, PIN 1
IS VOLTAGE -10V?
NO
U3A OR ASSOCIATED COMPONENTS
YES
CHECK LOGIC LEVEL AT U2B, PIN 4
IS LOGIC LEVEL LOW?
NO
CHECK LOGIC LEVEL AT U1, PIN 6
IS LOGIC LEVEL HIGH?
NO
U1 OR µP DATA BUS
YES
CHECK LOGIC LEVEL AT XA3, PIN 22
IS LOGIC LEVEL HIGH?
NO
A11S17 OR WIRING
YES
U2B
YES
CHECK WAVEFORM AT U8D, PIN 12
IS WAVEFORM PRESENT?
YES
U10C, Q4, OR ASSOCIATED COMPONENTS
NO
CHECK VOLTAGE AT A3TP3
IS VOLTAGE PER TABLE 7-14?
YES
U8D OR ASSOCIATED COMPONENTS
NO
CHECK VOLTAGE AT U3B PIN 7
IS VOLTAGE -10V?
NO
U3B OR ASSOCIATED COMPONENTS
YES
U5, U8A, OR µP DATA BUS
B
CHECK VOLTAGE AT U3A, PIN 1
IS VOLTAGE -10V?
NO
U3A OR ASSOCIATED COMPONENTS
YES
CHECK LOGIC LEVEL AT U2D, PIN 13
IS LOGIC LEVEL LOW?
NO
CHECK LOGIC LEVEL AT U1, PIN 5
IS LOGIC LEVEL HIGH?
NO
U1 OR µP DATA BUS
YES
CHECK LOGIC LEVEL AT XA3, PIN 21
IS LOGIC LEVEL HIGH?
NO
A11S14 OR WIRING
YES
U2D
YES
CHECK WAVEFORM AT U9D, PIN 12
IS WAVEFORM PRESENT?
YES
U9B, Q5 OR ASSOCIATED COMPONENTS
NO
CHECK VOLTAGE AT A3TP4
IS VOLTAGE PER TABLE 7-14?
YES
U9D OR ASSOCIATED COMPONENTS
NO
CHECK VOLTAGE AT U3B, PIN 7
IS VOLTAGE -10V?
NO
U3B OR ASSOCIATED COMPONENTS
YES
U6, U9A, OR µP DATA BUS

Figure 7-40. Error Code 22 Troubleshooting Flowchart (Sheet 2 of 3)

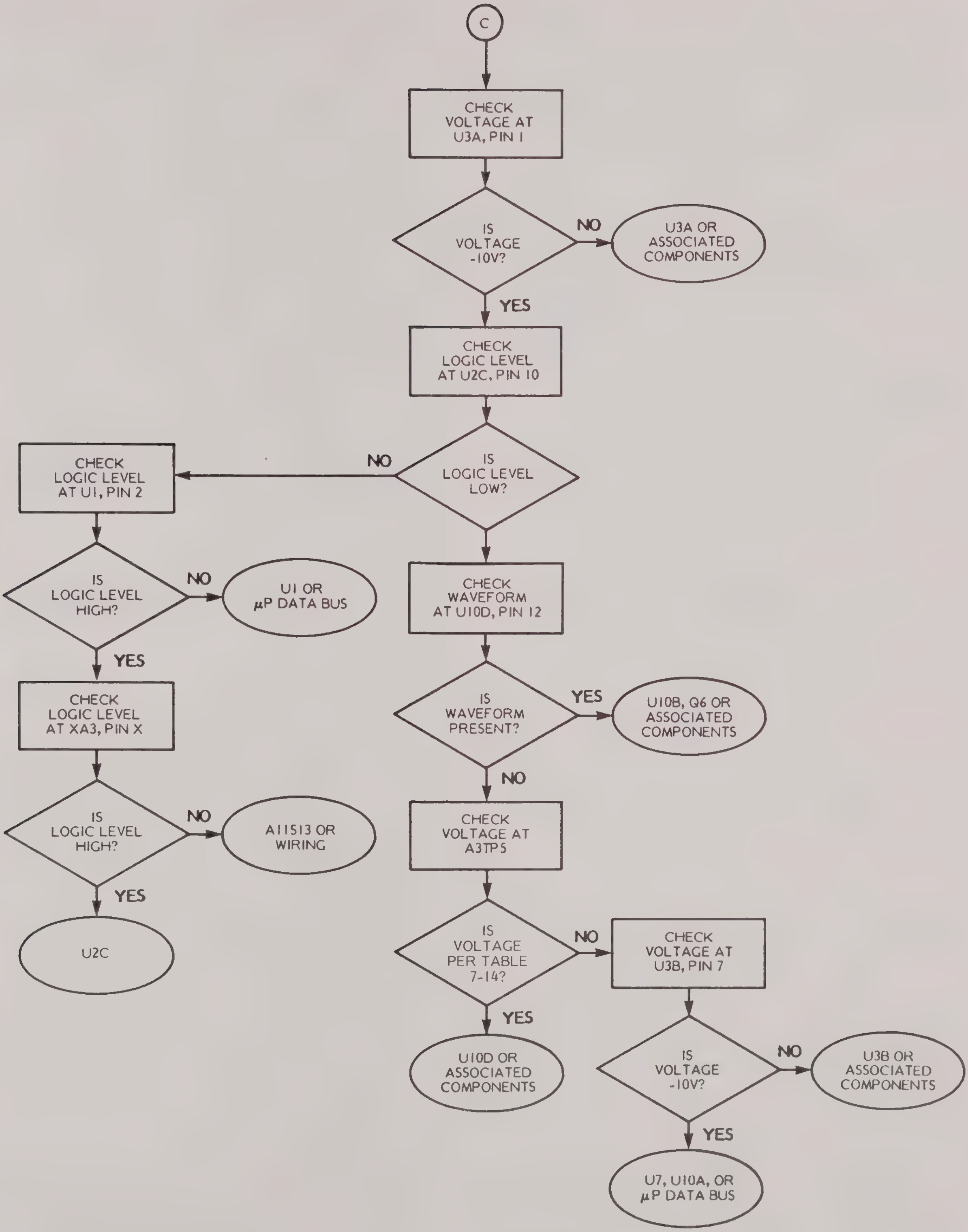

C
CHECK VOLTAGE AT U3A, PIN 1
IS VOLTAGE -10V?
NO
U3A OR ASSOCIATED COMPONENTS
YES
CHECK LOGIC LEVEL AT U2C, PIN 10
IS LOGIC LEVEL LOW?
NO
CHECK LOGIC LEVEL AT U1, PIN 2
IS LOGIC LEVEL HIGH?
NO
U1 OR μP DATA BUS
YES
CHECK LOGIC LEVEL AT XA3, PIN X
IS LOGIC LEVEL HIGH?
NO
A11S13 OR WIRING
YES
U2C
CHECK WAVEFORM AT U10D, PIN 12
IS WAVEFORM PRESENT?
YES
U10B, Q6 OR ASSOCIATED COMPONENTS
NO
CHECK VOLTAGE AT A3TP5
IS VOLTAGE PER TABLE 7-14?
NO
CHECK VOLTAGE AT U3B, PIN 7
YES
U10D OR ASSOCIATED COMPONENTS
IS VOLTAGE -10V?
NO
U3B OR ASSOCIATED COMPONENTS
YES
U7, U10A, OR μP DATA BUS

Figure 7-40. Error Code 22 Troubleshooting Flowchart (Sheet 3 of 3)

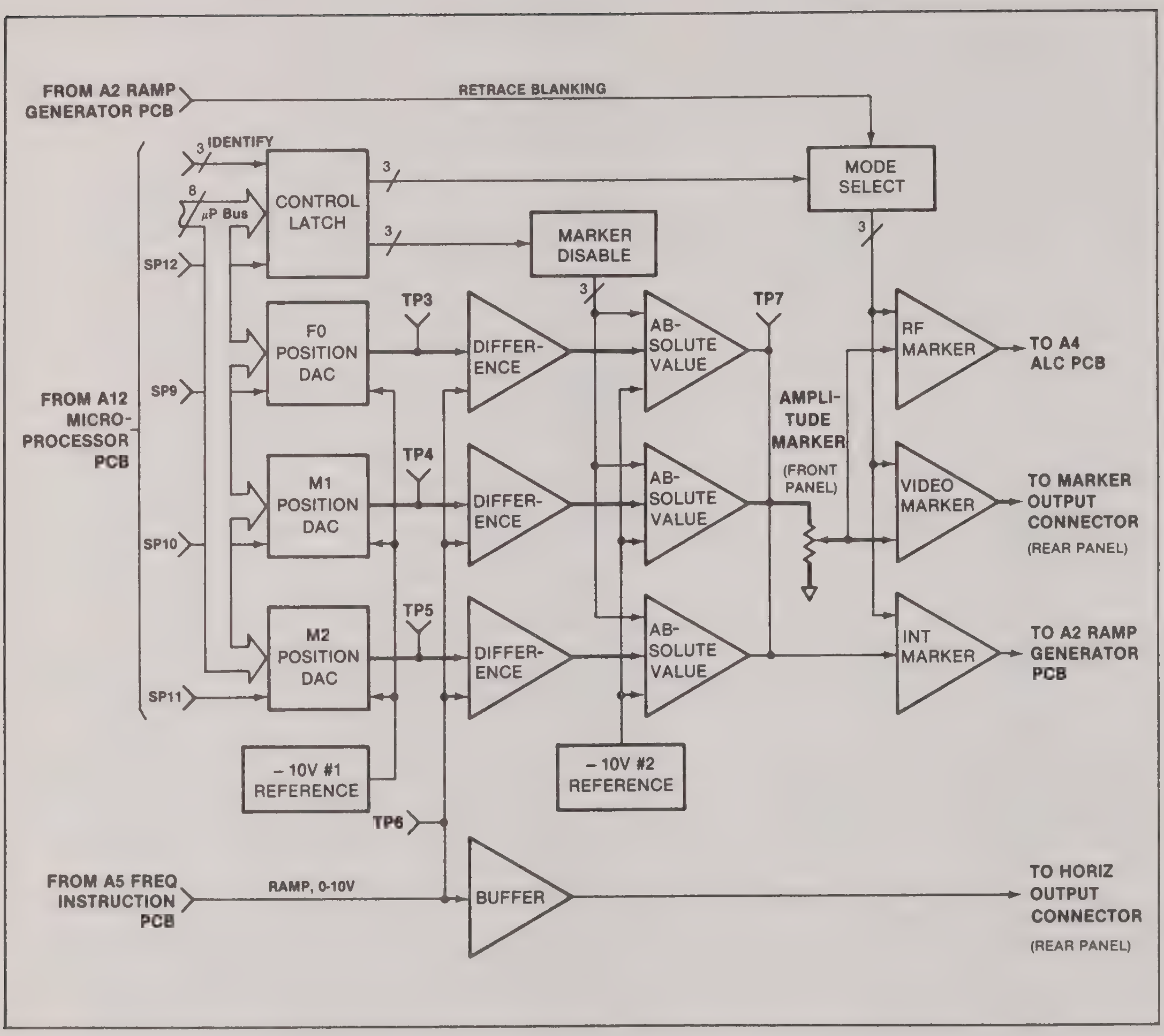

FROM A2 RAMP GENERATOR PCB
RETRACE BLANKING
3 IDENTIFY
8
μP Bus
CONTROL LATCH
3
3
MODE SELECT
3
MARKER DISABLE
3
SP12
FROM A12 MICRO-PROCESSOR PCB
SP9
SP10
SP11
F0 POSITION DAC
M1 POSITION DAC
M2 POSITION DAC
TP3
TP4
TP5
TP6
TP7
DIFFER-ENCE
DIFFER-ENCE
DIFFER-ENCE
AB-SOLUTE VALUE
AB-SOLUTE VALUE
AB-SOLUTE VALUE
AMPLI-TUDE MARKER
(FRONT PANEL)
RF MARKER
VIDEO MARKER
INT MARKER
TO A4 ALC PCB
TO MARKER OUTPUT CONNECTOR
(REAR PANEL)
TO A2 RAMP GENERATOR PCB
– 10V #1 REFERENCE
– 10V #2 REFERENCE
FROM A5 FREQ INSTRUCTION PCB
RAMP, 0-10V
BUFFER
TO HORIZ OUTPUT CONNECTOR
(REAR PANEL)

Figure 7-41. Error Code 22 Troubleshooting Diagram

7-11 A4 AUTOMATIC LEVEL CONTROL (ALC) PCB

7-11.1 A4 Automatic Level Control (ALC) PCB, Circuit Description

The A4 Automatic Level Control (ALC) PCB, along with circuitry on the RF Deck and the YIG Driver PCB (A6, A7, A8, or A9), provides for the automatic leveling of the RF output power. The A4 PCB also receives the ATTN 1 thru ATTN 4 control bits from the microprocessor and routes these bits to the Option 2 Step Attenuator current-driver circuits on the A10 PCB. The schematic diagram for the A4 PCB (3 sheets) is contained in Figure 7-44.

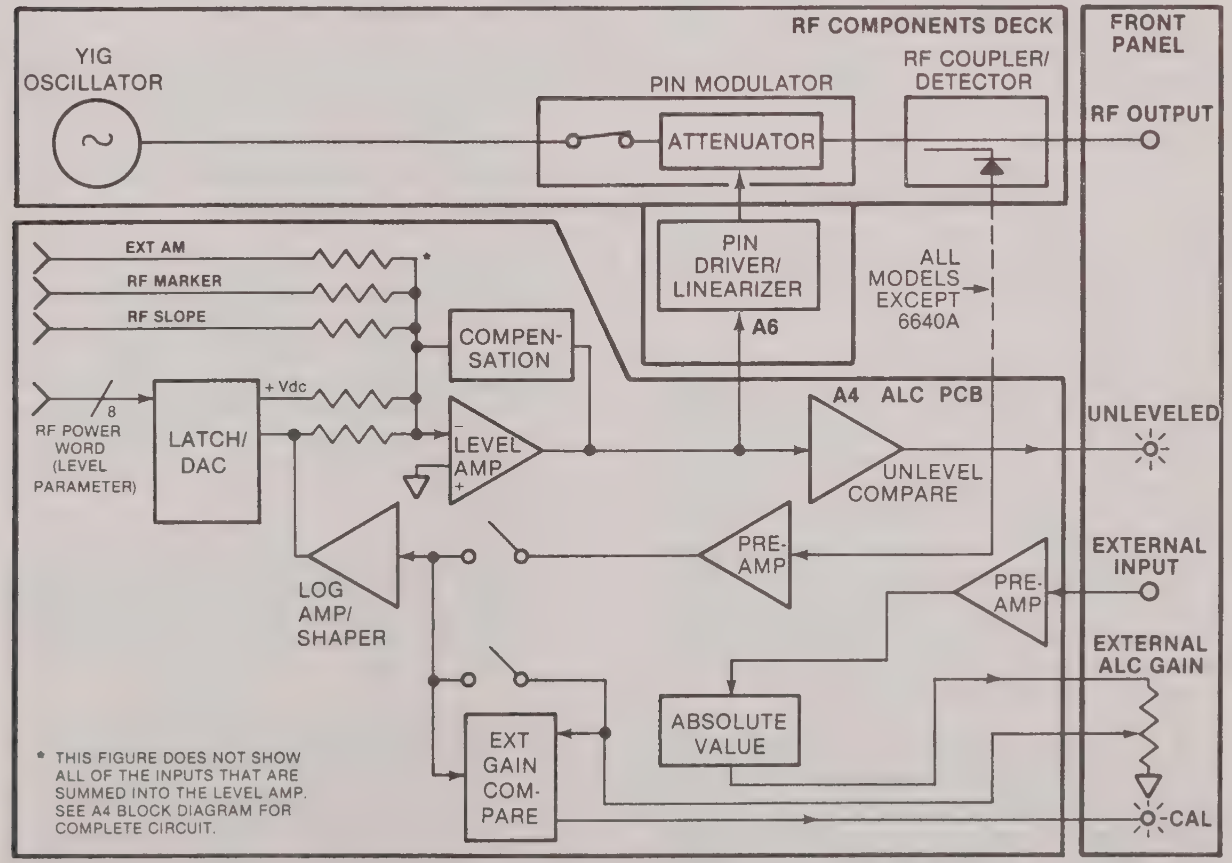
The sweep generator ALC loop (Figure 7-42) consists of the following circuits and components:

a. PIN Switch and RF Coupler/Detector. These components are on the RF Deck.

b. PIN Driver/Linearizer circuits. These circuits are on the individual A6, A7, A8, and A9 YIG Driver PCBs.

c. Preamp (3), Absolute Value, Ext Gain Compare, Log Amp/Shaper, Latch/DAC, Level Amp, Compensation, and Unlevel Compare circuits. These circuits are on the A4 PCB.

As shown in Figure 7-42, the output from the RF Oscillator is applied to the RF Coupler/Detector via the PIN Switch. A sample of the RF power signal, attenuated by approximately 16 dB, is coupled to the RF detector. If internal leveling has been selected, the detector output signal is applied


RF COMPONENTS DECK
FRONT PANEL
YIG OSCILLATOR
PIN MODULATOR
RF COUPLER/ DETECTOR
ATTENUATOR
RF OUTPUT
EXT AM
RF MARKER
RF SLOPE
*
PIN DRIVER/ LINEARIZER
A6
ALL MODELS EXCEPT 6640A
COMPEN- SATION
8
RF POWER WORD (LEVEL PARAMETER)
LATCH/ DAC
+Vdc
LEVEL AMP
A4 ALC PCB
UNLEVEL COMPARE
UNLEVELED
PRE- AMP
PRE- AMP
EXTERNAL INPUT
LOG AMP/ SHAPER
EXTERNAL ALC GAIN
ABSOLUTE VALUE
EXT GAIN COM- PARE
CAL

* THIS FIGURE DOES NOT SHOW ALL OF THE INPUTS THAT ARE SUMMED INTO THE LEVEL AMP. SEE A4 BLOCK DIAGRAM FOR COMPLETE CIRCUIT.

Figure 7-42. Sweep Generator Overall Leveling Loop

to the Log Amp/Shaper via the appropriate Preamp circuit. If external leveling has been selected, the external detector output signal is applied to the Log Amp/Shaper via the Absolute Value circuit.

At the Log Amp/Shaper, the detector output signal is amplified and shaped and its relationship to the main power signal is changed from logarithmic to linear. The linear-change-with-power-level-change output from the Log Amp/Shaper is summed at the Level Amp with the voltage output from the Reference DAC. The output from the DAC is the analog voltage representation of the digital power word that was selected using the front panel LEVEL pushbutton. Another reason for including a log amplifier in the ALC loop is to provide the loop with the means for setting output power in dBm.

The output of the Level Amp is applied to either the A6, A7, A8, or A9 PCB PIN Driver/Linearizer circuit (depending on which YIG oscillator band is supplying the output power). The A6, A7, A8, and A9 PIN Driver/Linearizer circuits provide an adjustment for customizing the loop gain for each YIG oscillator band.

The A4 PCB leveling circuit (Figure 7-43) provides overall control of the RF output power. The A4 PCB has two preamplifiers for internal leveling: a Het Band (U4) and YIG Band(s) circuit (U6).

For external leveling, both a preamplifier (U7) and an Absolute Value circuit (U8A, U8B) are provided. The Absolute Value circuit allows a positive or negative detector to be used for external leveling; the circuit's output is positive for either input sense. If POWER METER leveling has been selected, the **L PWR MTR GAIN** control line is TRUE. When TRUE, this line activates a switch that causes the circuit gain to be reduced to accommodate the larger voltage supplied by the power meter video output.

The Ext Gain Comparator circuit (U11A, U11B), in conjunction with the front panel EXTERNAL ALC GAIN control, provides for calibrating the gain of the external leveling loop. When the EXTERNAL ALC GAIN control is pushed in, the microprocessor causes either the L <2 GHz or the L >2 GHz line to go TRUE (depending upon the frequency range that has been selected). Either of these lines going TRUE places its associated detector signal on the Ext Gain Comparator's comparison input. With this signal in place, the EXTERNAL ALC GAIN control is adjusted until the voltage of the external detector is equal to the voltage of the internal detector. When these two voltages are equal, the **L EGD** (External Gain Detected) line will go TRUE and light the CAL indicator LED. The CAL indicator will remain lit until the EXTERNAL ALC GAIN control is released and control is restored to the external signal path.

The output signal from the external or internal preamplifier circuit is applied to the Log Amp/Shaper circuit (Figure 7-44, Sheet 2). The Log Amp/Shaper, with its associated temperature compensation and voltage offset circuits, provides gain and shaping for its signal.

The Level Amp (U21) and its associated input circuitry gives the A4 PCB overall control over the level of the sweep generator output-power signal. In addition to the Log Amp, the Level Amp input circuitry consists of the following:

a. DAC Circuit. This circuit (U22, U19B) converts the 8-bit digital-power-level control group from the microprocessor into an analog reference voltage. This voltage is used to set the sweep generator output power level. The microprocessor digital word represents the dBm value that was set using the front panel LEVEL pushbutton.

b. Level-Dip Logic Circuit. This circuit (Q2) causes the PIN Switch Attenuator (Figure 7-42) to go to maximum attenuation ("dip" RF power) when any of the following occurs:

   1. The **L LEVEL DIP** line from the A2 PCB goes TRUE (paragraph 7-9.lb).
   2. The **L RETRACE BLANKING** line from the A2 PCB goes TRUE (provided the front panel RETRACE RF switch is OFF).

Para 7-11.1 (cont'd.)

3. The front panel RF OFF switch is switched off.

When any of the above three conditions occurs, the Level-Dip Logic circuit output goes HIGH and causes the PIN Switch Attentuator to go to maximum attenuation. The L CW MODE line that also connects to this circuit prevents a dip in power when the sweeper is in a CW mode and the rear panel HORIZ OUTPUT DURING CW switch is ON.

c. RF MARKER Signal Line. This input is the 0 to +5V triangular waveform from the A3 Marker Generator PCB (paragraph 7-10.1a). This waveform causes the output power to "dip" up to 5 dB at the marker frequency, depending on the setting of the MARKER AMPLITUDE control.

d. RF SLOPE Control. This input is from the front panel RF SLOPE control. It provides a linear boost in output power as the RF oscillator sweeps across its frequency band. The RF SLOPE input is a negative-going voltage ramp that is proportional to frequency; it provides an increase in output power at the higher frequencies.

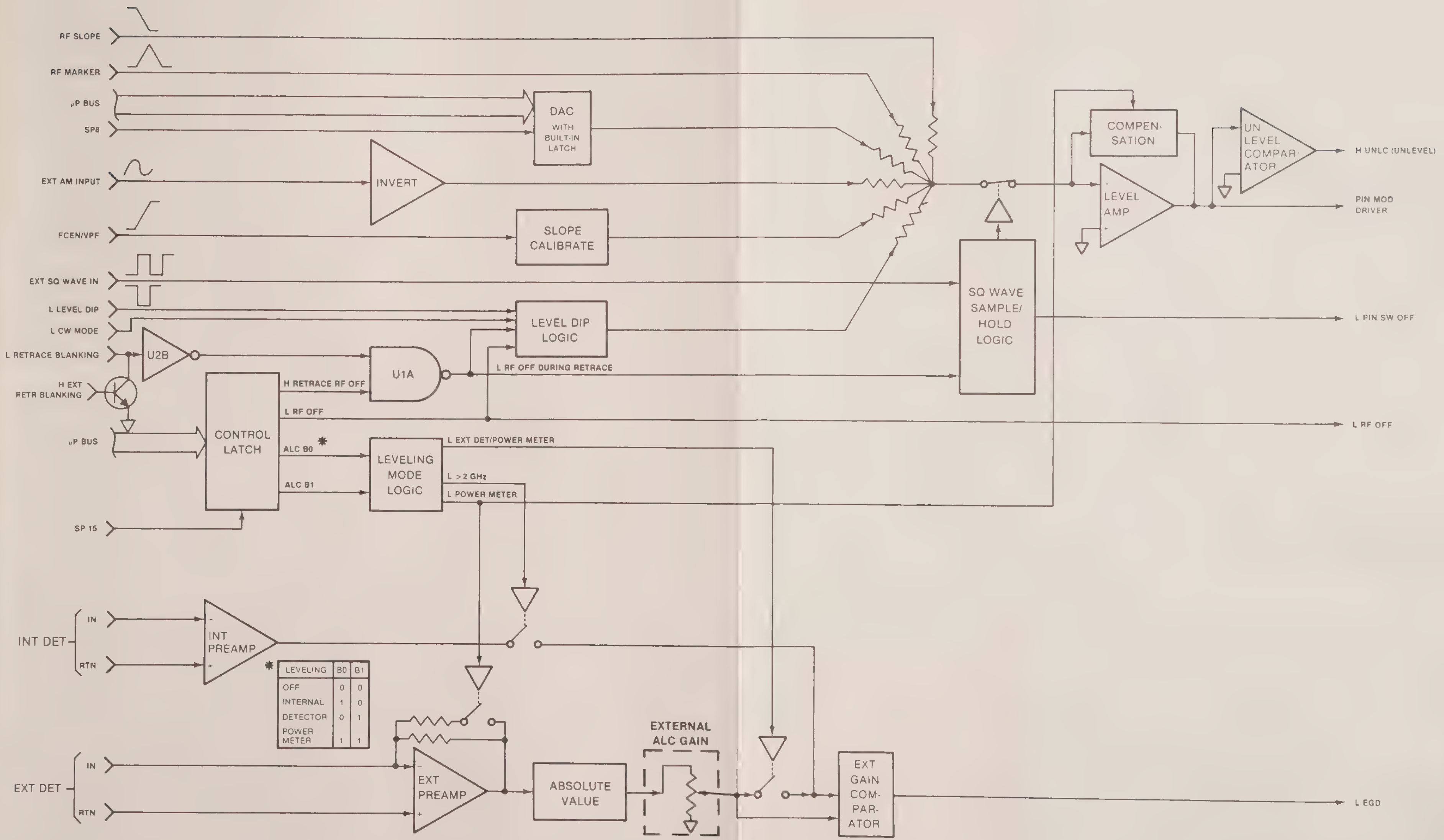
e. Slope Calibrate Circuit. This circuit (U19D) calibrates the sweep-frequency output to be optimally horizontal when the RF SLOPE control is OFF. The input to this circuit is a 0 to 10V ramp from the A5 PCB. The output of the circuit can be either a positive or a negative analog voltage, the value of which is proportional to frequency.

f. EXT AM INPUT Connector. This input is from the EXT AM INPUT rear panel connector. This modulation signal is inverted and summed into the Level Amp. Its bandwidth is rated from dc to 50 kHz; signal sensitivity is 1 dB/V.

g. Sq Wave Sample/Hold Logic Circuit. This circuit (Q3, U2C, U1D, U23A, U23B, U2F, U23C, U23D, U20B) provides for square wave modulation of the RF output signal, at rates up to 30 kHz. The inputs to this circuit are the **EXT SQ WAVE IN** signal from the rear panel connector and the **L RF OFF DURING RETRACE** control line from NAND gate U1A. When the **EXT SQ WAVE IN** signal goes negative or when the **L RF OFF DURING RETRACE** line goes TRUE, the **L PIN SW OFF** line goes TRUE and opens the PIN Switch (Figure 7-42). When open, the PIN Switch attenuates the RF output signal by ≈ 40 dB. When the EXT SQ WAVE IN signal again goes positive (or **L RF OFF DURING RETRACE** goes FALSE), the **L PIN SW OFF** line goes FALSE and closes the PIN switch. The ALC loop cannot respond fast enough to track the changes in RF output during square-wave modulation. Therefore, a sample-and-hold network is used to open the ALC loop and hold the previous PIN switch drive current when modulation is applied.

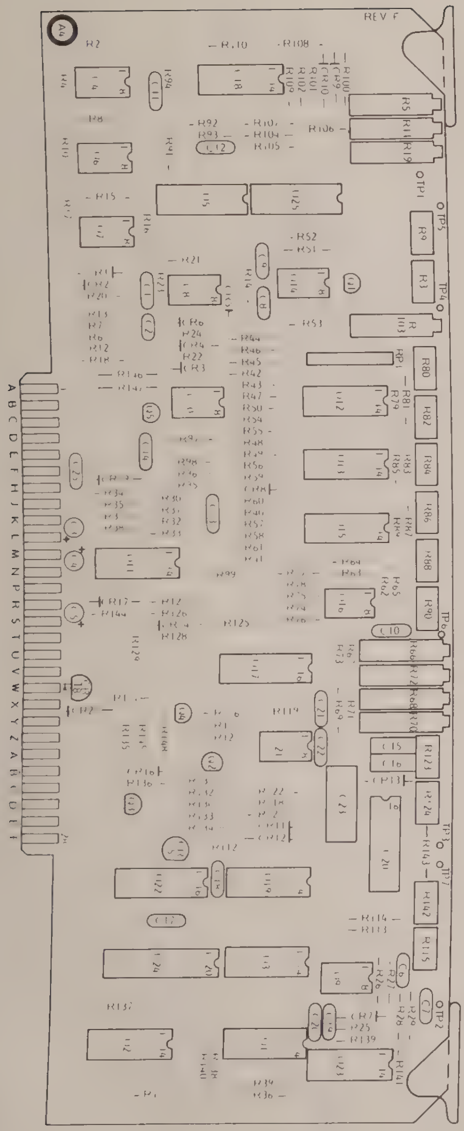
The two remaining blocks on this diagram are the Compensation and the Unlevel Comparator circuits. The Compensation circuit (C23, CR13) is used to stabilize the loop. The circuit also slows the response of the ALC loop when power meter leveling has been selected. Slowing the loop's response is necessary because a power meter's response to variations in output power is much slower than a detector's response.

The Unlevel Comparator circuit (U11D) provides drive for the front panel UNLEVEL indicator LED. If the output of the Level Amp goes positive, indicating more power has been called for than the YIG oscillator can deliver, the **H UNLC** line goes TRUE and lights the UNLEVEL indicator LED.

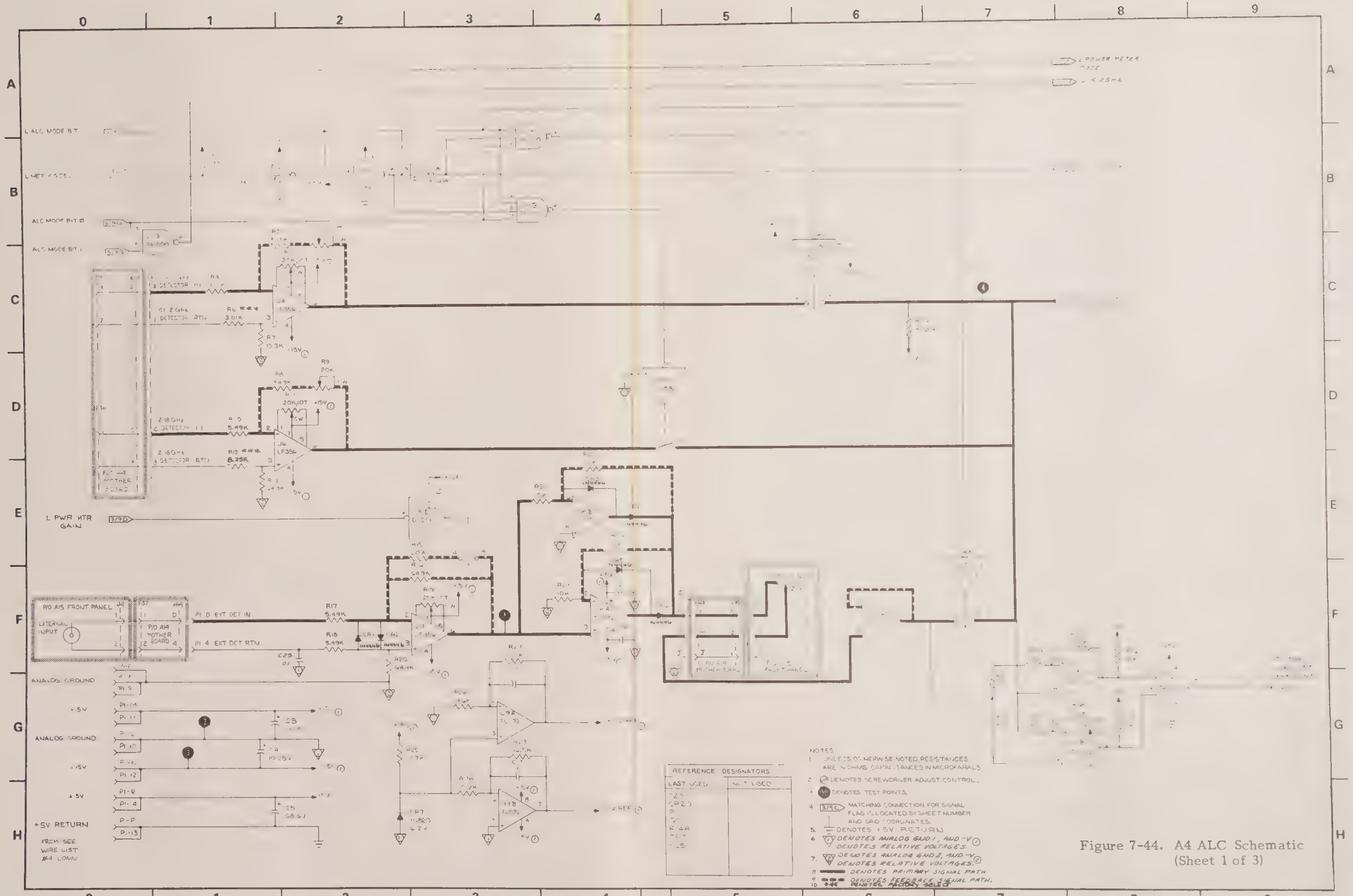

RF SLOPE
RF MARKER
µP BUS
SP8
EXT AM INPUT
FCEN/VPF
EXT SQ WAVE IN
L LEVEL DIP
L CW MODE
L RETRACE BLANKING
H EXT RETR BLANKING
µP BUS
SP 15
DAC WITH BUILT-IN LATCH
INVERT
SLOPE CALIBRATE
LEVEL DIP LOGIC
U2B
U1A
L RF OFF DURING RETRACE
H RETRACE RF OFF
L RF OFF
CONTROL LATCH
ALC B0 *
ALC B1
LEVELING MODE LOGIC
L EXT DET/POWER METER
L >2 GHz
L POWER METER
SQ WAVE SAMPLE/ HOLD LOGIC
COMPEN-SATION
LEVEL AMP
UN LEVEL COMPAR-ATOR
H UNLC (UNLEVEL)
PIN MOD DRIVER
L PIN SW OFF
L RF OFF
INT DET
IN
RTN
INT PREAMP
EXT DET
IN
RTN
EXT PREAMP
ABSOLUTE VALUE
EXTERNAL ALC GAIN
EXT GAIN COM-PAR-ATOR
L EGD

* LEVELING	B0	B1
OFF	0	0
INTERNAL	1	0
DETECTOR	0	1
POWER METER	1	1

Figure 7-43. A4 Automatic Level Control (ALC) PCB Functional Block Diagram


A4
REV F
OTP1
OTP2
TP3
TP4
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z

A4 PCB Parts Locator Diagram


L ALC MODE BIT
L MET 5 SEL
ALC MODE BIT 0
ALC MODE BIT 1
L PWR MTR GAIN
P10 A15 FRONT PANEL
EXTERNAL INPUT
P10 A14 MOTHER BOARD
P1 D EXT DET IN
P1 4 EXT DET RTN
ANALOG GROUND
+5V
-15V
+15V
+5V RETURN
FROM SEE WIRE LIST #4 LOOM
LF356
R7 13.3K
R9 20K
R10 5.49K
R12 8.25K
R17 5.49K
R18 5.49K
20K 10T
C25 .01
C4 68.6
3/9C
REFERENCE DESIGNATORS
LAST USED
NOT USED

NOTES
1 UNLESS OTHERWISE NOTED, RESISTANCES ARE IN OHMS, CAPACITANCES IN MICROFARADS
2 DENOTES SCREWDRIVER ADJUST CONTROL.
3 ⑩ DENOTES TEST POINTS.
4 3/9C MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
5. DENOTES +5V RETURN
6 DENOTES ANALOG GND 1, AND -V ① DENOTES RELATIVE VOLTAGES.
7. DENOTES ANALOG GND 2, AND -V ② DENOTES RELATIVE VOLTAGES.
8 DENOTES PRIMARY SIGNAL PATH
9 DENOTES FEEDBACK SIGNAL PATH.
10 *** DENOTES FACTORY SELECT

Figure 7-44. A4 ALC Schematic (Sheet 1 of 3)

parts locator

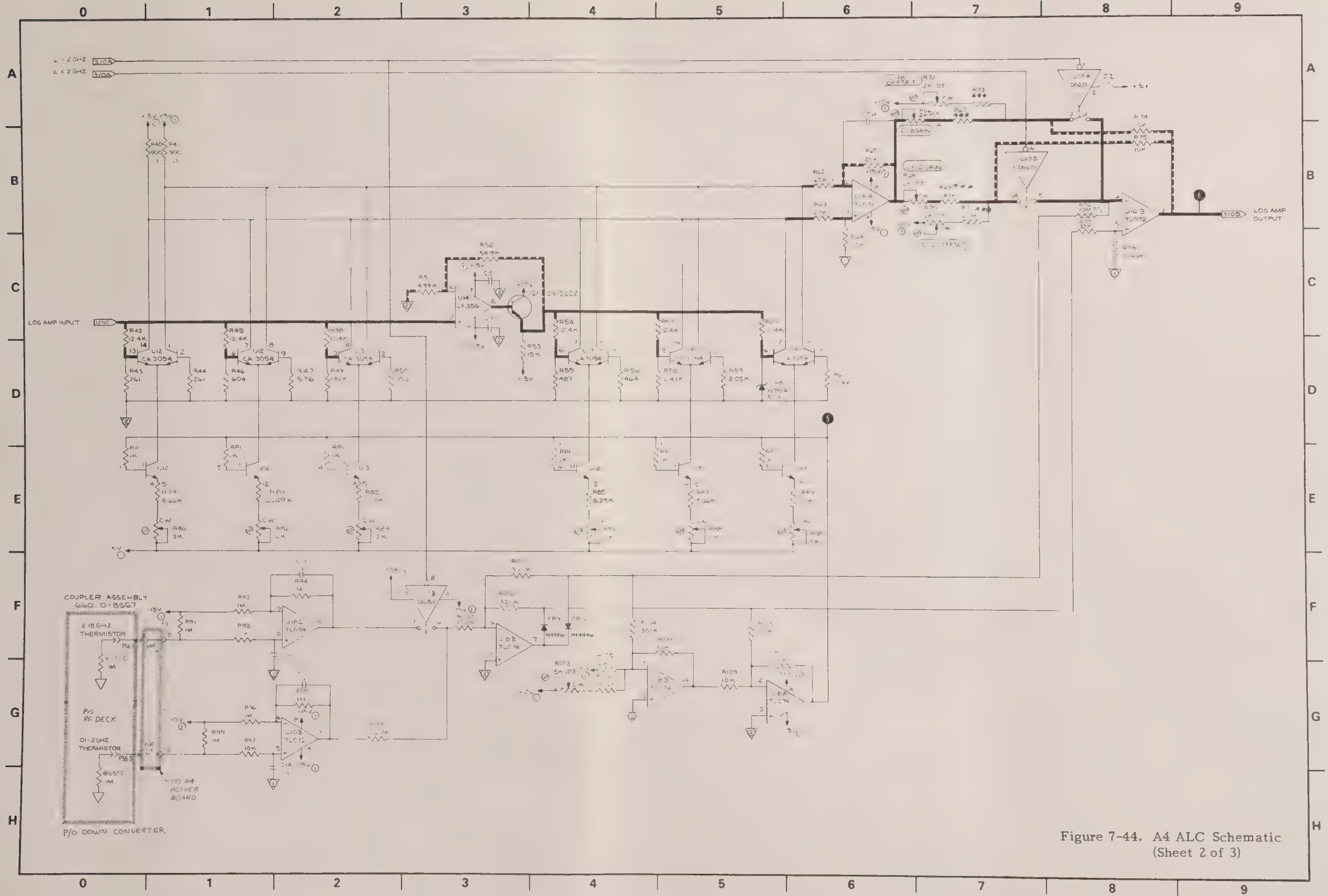

L > 2 GHZ
L < 2 GHZ
LOG AMP INPUT
LOG AMP OUTPUT
R42 12.4K
R43 261
R44 261
U12 CA 3054
R45 12.4K
R46 604
R47 576
R49
R50
R52 54.9K
R5 499K
U14 LF356
R53 15K
-5V
R54 2.4K
R55 487
R56 464
R59 2.05K
R62
R63
R66 2K
R67
R72 2K
OFFSET
GAIN
U16 B TL072
U17 D
U17 A DG201
R79
R80 2K
R81
R82
R83
R84 2K
R85 8.25K
R86
R87
R90
+5V
-15V
+15V
R40
R41
R91 1M
R92 1M
R93
R94 1M
R95 1M
R96 1M
R97 10K
U18 C TLC274
U10 B TLC72
U18 D DG201
U8 B TLC74
CR4 1N4446
CR5 1N4446
R103 5K
R109 10K
U6 A TLC74
-10V
COUPLER ASSEMBLY 6600-8567
2-18GHZ THERMISTOR
01-2GHZ THERMISTOR
@25°C 1M
P/O RF DECK
P/O A14 MOTHER BOARD
P/O DOWN CONVERTER

Figure 7-44. A4 ALC Schematic
(Sheet 2 of 3)

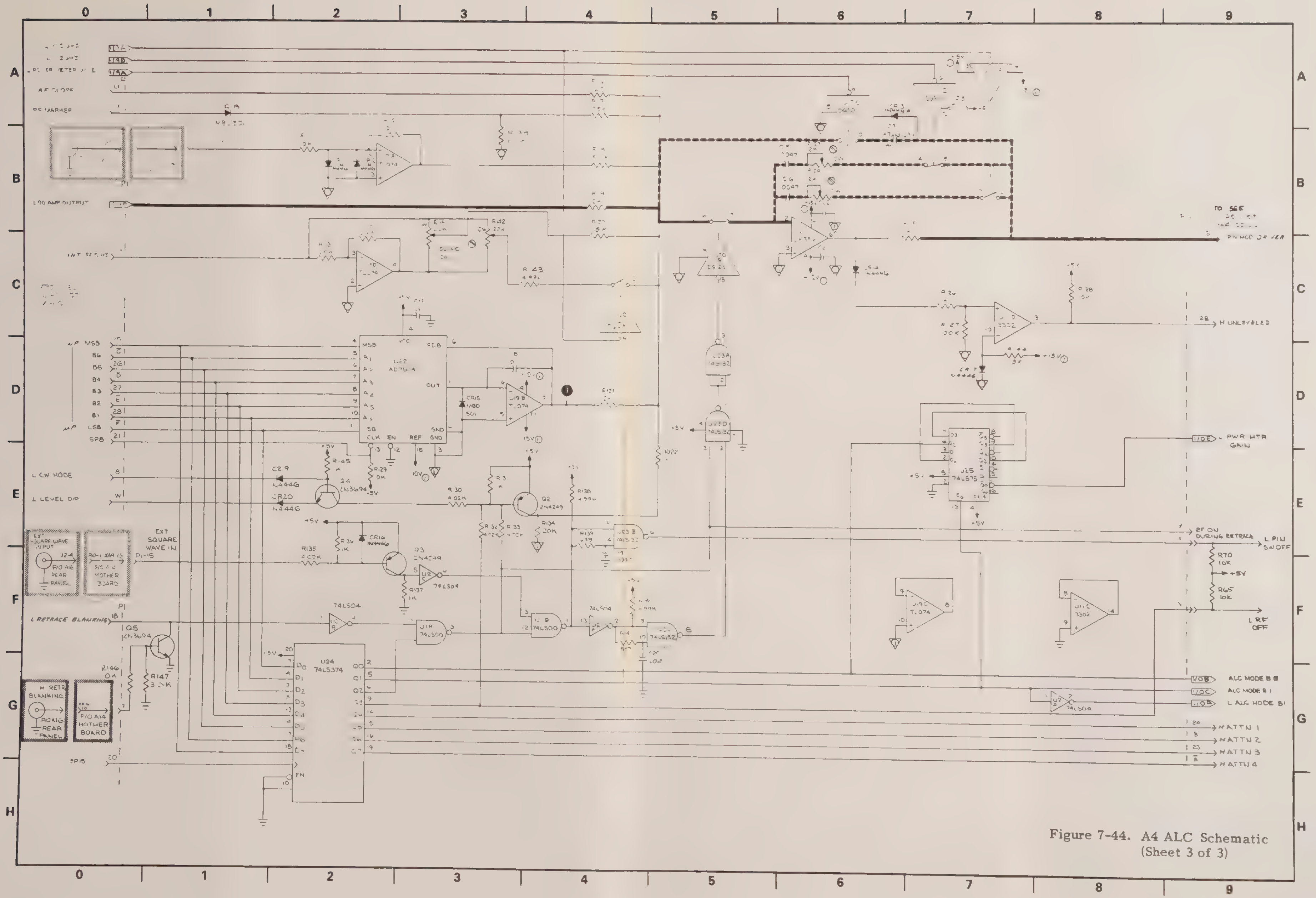

LOG AMP OUTPUT
INT REF
µP MSB
B6
B5
B4
B3
B2
B1
µP LSB
SPB
L CW MODE
L LEVEL DIP
EXT SQUARE WAVE INPUT
J2-4
P/O A16 REAR PANEL
P/O A14 MOTHER BOARD
EXT SQUARE WAVE IN
P1-15
L RETRACE BLANKING
H RETR BLANKING
P/O A16 REAR PANEL
P/O A14 MOTHER BOARD
SP15
U22 AD7524
MSB
FDB
VCC
OUT
GND
CLK
EN
REF
SB
U19B TL074
CR15 MBD 501
R121
R122
CR9 IN4446
CR20 IN4446
Q4 2N3694
R145
R129 10K
R30 4.02K
Q2 2N4249
R138 4.99K
R134 20K
R135 4.02K
R136 1K
CR16 IN4446
Q3 2N4249
R137 1K
Q5 2N3694
R146 10K
R147 3.01K
U24 74LS374
U2 74LS04
U1A 74LS00
U1D 74LS00
U23B 74LS132
U23A 74LS132
U23D 74LS132
U23C 74LS132
R43 4.99K
R42 20K
U25 74LS75
U19C TL074
U11C 3302
R28
R27 10K
R44 5K
CR17 IN4446
R70 10K
R65 10K
+5V
TO SGE
PIN MOD DRIVER
H UNLEVELED
PWR MTR GAIN
RF ON DURING RETRACE
L PIN SWOFF
L RF OFF
ALC MODE B0
ALC MODE B1
L ALC MODE B1
H ATTN 1
H ATTN 2
H ATTN 3
H ATTN 4
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H

Figure 7-44. A4 ALC Schematic
(Sheet 3 of 3)

7-11.2 Sweep Generator Automatic-Leveling-Control (ALC) Loop, Troubleshooting Information and Data

Error codes 15-20 report on the automatic leveling control (ALC) loop. The microprocessor routines associated with these codes monitor the front panel UNLEVEL indicator (H UNL status line). If UNLEVEL is lit

- in the heterodyne (Het) band, error code 15 appears;
- in the YIG 1 band, error code 16 appears;
- in the YIG 2 band, error code 17 appears;
- in the YIG 3 band, error code 18 appears;
- in the YIG 4 band, error code 19 appears;
- anywhere across the range, error code 20 appears.

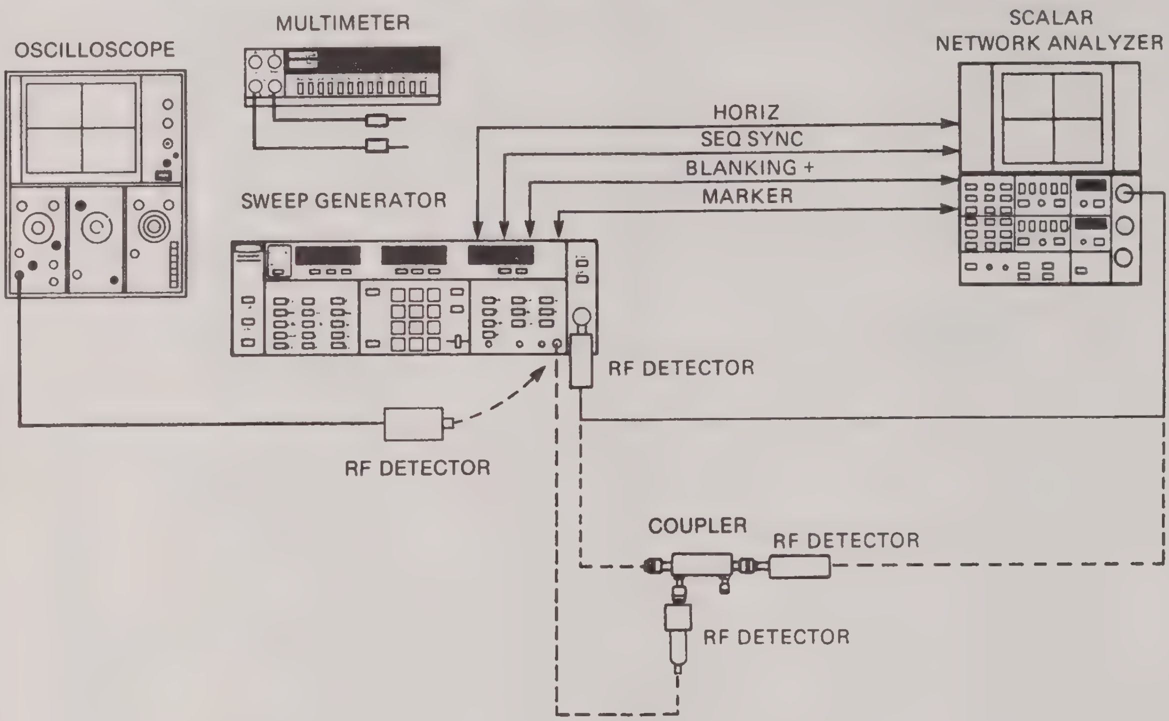
To test the ALC loop, the error code routines function as follows: The routines for error codes 15 thru 19 call up CW operation and set their band to midfrequency. The routine for error code 20 calls up the analog (A2 PCB) sweep ramp and causes it to sweep the frequency across 95% of its entire range. Because of this test method, a band error code (15-19) should always result in a range error code (20) also. However, because power may not always be unlevel in the middle of a band, the range error code can occur independently of a band error code.

To accomplish the ALC error-code tests, the microprocessor configures the ALC loop circuits as follows:

ERROR CODE	MODEL	F CENTER DAC FREQ. (APPROX.)
15	6609A, 6617A 6647A, 6648A, 6653A	1 GHz
16	6617A, 6621A, 6621A-40, 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A	5 GHz
16	6642A	22 GHz
17	6621A, 6621A-40, 6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A	10 GHz
18	6629A, 6629A-40, 6637A, 6637A-40, 6638A, 6647A, 6648A, 6653A, 6659A	15 GHz
19	6653A, 6659A	23 GHz
20	6609A	1 GHz
	6617A	5 GHz
	6621A, 6621A-40	7 GHz
	6629A, 6629A-40	13 GHz
	6637A, 6637A-40, 6647A	9 GHz
	6638A, 6648A	10 GHz
	6653A, 6659A	13 GHz
	6642A	29 GHz

All of the ALC error-code routines monitor the **H UNLEVELED** line at the microprocessor input buffer. If this line goes LOW, the appropriate error code is displayed.

The test equipment setup for troubleshooting error codes 15-20 is provided in Figure 7-45; a test setup for troubleshooting the 6642A 26.5 to 40 GHz band is provided in Figure 7-46; a troubleshooting flowchart is provided in Figure 7-47, and individual troubleshooting block diagrams are provided in Figure 7-48 through 7-55. ALC loop waveforms are shown in Figure 7-56, and a tabulation giving minimum output power (YIGs) and insertion loss values for the RF components is provided in Table 7-16.


MULTIMETER
OSCILLOSCOPE
SCALAR NETWORK ANALYZER
HORIZ
SEQ SYNC
BLANKING +
MARKER
SWEEP GENERATOR
RF DETECTOR
RF DETECTOR
COUPLER
RF DETECTOR
RF DETECTOR

Initial Control Settings

Sweep Generator

FREQUENCY RANGE: F1-F2
TRIGGER: AUTO
MARKERS: INTENSITY
LEVELING: INTERNAL (DETECTOR*)
RETRACE RF: Off
RF ON: On
CW RAMP: On
RF SLOPE: OFF
LEVEL: 0 dBm
SWEEP TIME: 50 ms
F1: 10 MHz (Error Code 15, not 6642A)
  18 GHz (Error Code 15, 6642A)
  2 GHz (Error Code 16)
  8 GHz (Error Code 17)
  12.4 GHz (Error Code 18)
  18 GHz (Error Code 19)
  Low End (Error Code 20)

F2: 2 GHz (Error Code 15 not 6642A)
  26.5 GHz (Error Code 15, 6642A)
  8 GHz (Error Code 16)
  12.4 GHz (Error Code 17)
  18.6 (or 20) GHz (Error Code 18)
    (All models except 6653A/6659A)
  18.0 GHz (Error Code 18) Models 6653A/6659A
  26.5 GHz (Error Code 19)
  Wish End (Error Code 20)

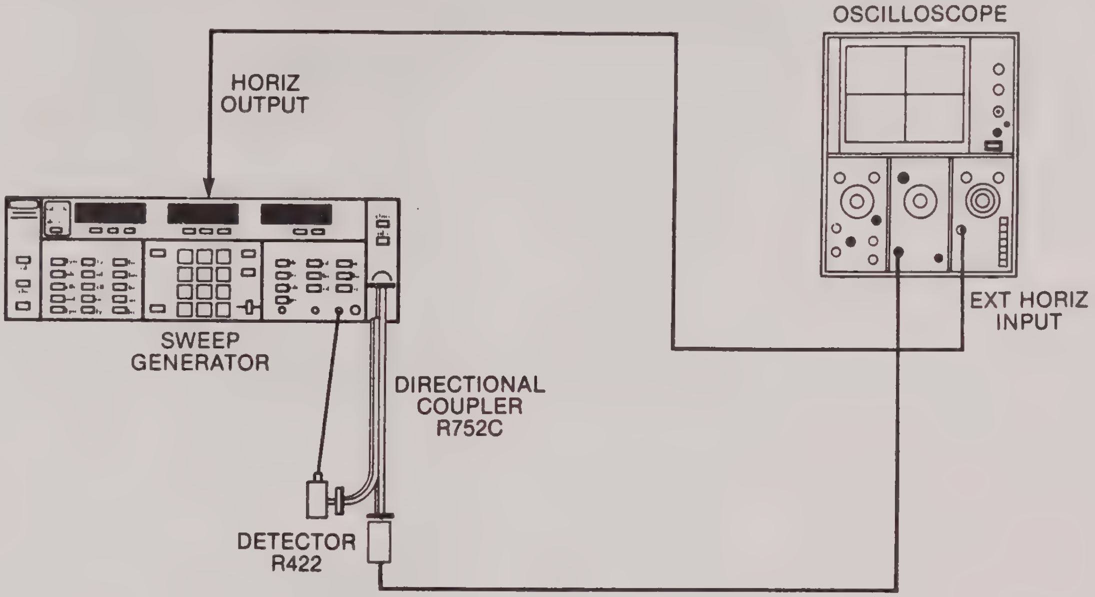
Scalar Network Analyzer

CHANNEL A ON: On
  INPUT: A
  MEMORY: Off
  dB PER DIVISION: 5
  REFERENCE dB/dBm: dBm
  SET (screwdriver pot): Midrange
  OFFSET: -00.00
CHANNEL B: Not Used
MARKER THRESHOLD: Midrange
REAL TIME: On
SMOOTHING: Off

POWER: ON

*External leveling shown by dashed-line connections.

Figure 7-45. Test Equipment Setup for Troubleshooting Error Codes 15 thru 20


OSCILLOSCOPE
HORIZ OUTPUT
SWEEP GENERATOR
DIRECTIONAL COUPLER R752C
DETECTOR R422
EXT HORIZ INPUT

Initial Control Settings

Sweep Generator

FREQUENCY RANGE: F1-F2
TRIGGER: AUTO
MARKERS: INTENSITY
LEVELING: INTERNAL (DETECTOR*)
RETRACE RF: Off
RF ON: On
CW RAMP: Off
RF SLOPE: OFF
LEVEL: 0 dBm
SWEEP TIME: 50 ms
F1: 26.5 GHz
F2: 40 GHz

Figure 7-46. Test Equipment Setup for Troubleshooting the Model 6642A ALC Loop

GENERAL INFORMATION FOR ALC LOOP TROUBLESHOOTING CHART

1. DC voltages for the A4, A6, A7, A8, and A9 PCBs may be measured at the following pins:

   A4P1 (edge connector)
   +5V – pins R(+) and P(-)
   +15V – pins M (+) and L (-)
   -15V – pins N (-) and L (+)

   A6P1 (edge connector)
   +5V – pins 12 (+) and 11 (-)
   +15V – pins 9 (+) and 21 (-)
   -15V – pins 10 (-) and 21 (+)

   A7, A8, or A9 P1
   +5V – pins 11 (+) and 10 (-)
   +15V – pins 8 (+) and 20 (-)
   -15V – pins 9 (-) and 20 (+)

2. In the case of multiple error codes, troubleshoot lowest-numbered codes first.

3. All logic levels are TTL.

Table 7-15. Available ALC Error Codes

MODEL NUMBER	AVAILABLE ERROR CODES
6609A	15 & 20
6617A	15, 16, & 20
6621A	16, 17, & 20
6621A-40	16, 17, & 20
6629A	17, 18, & 20
6629A-40	17, 18, & 20
6637A	16, 17, 18, & 20
6637A-40	16, 17, 18, & 20
6638A	16, 17, 18, & 20
6642A	16 & 20
6647A	15, 16, 17, 18, & 20
6648A	15, 16, 17, 18, & 20
6653A	16, 17, 18, 19, & 20
6659A	15, 16, 17, 18, 19, & 20

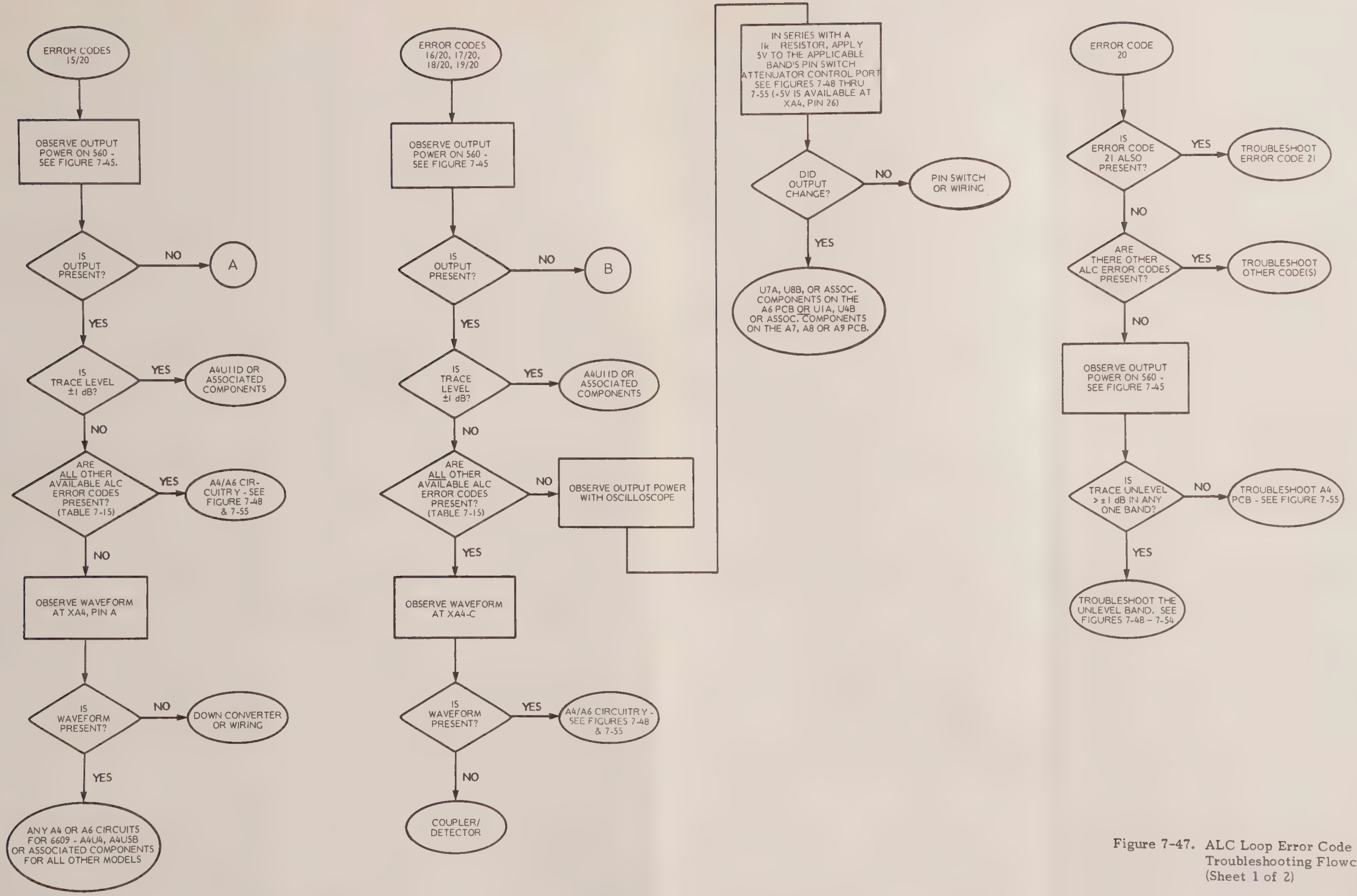
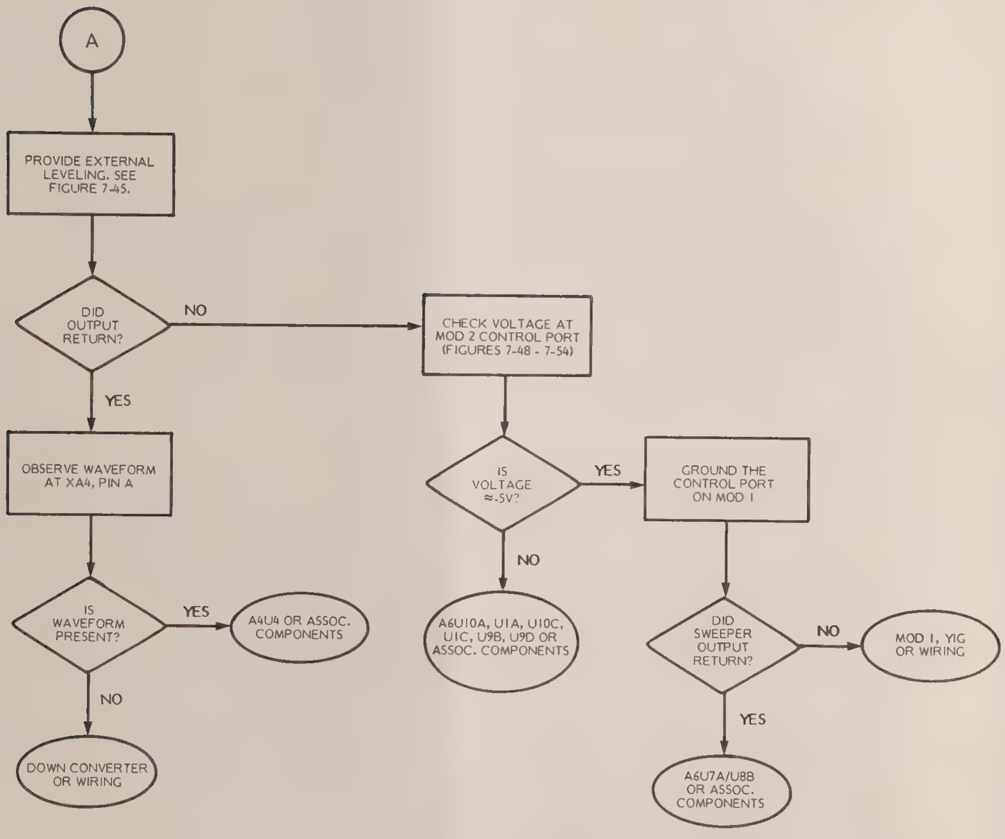
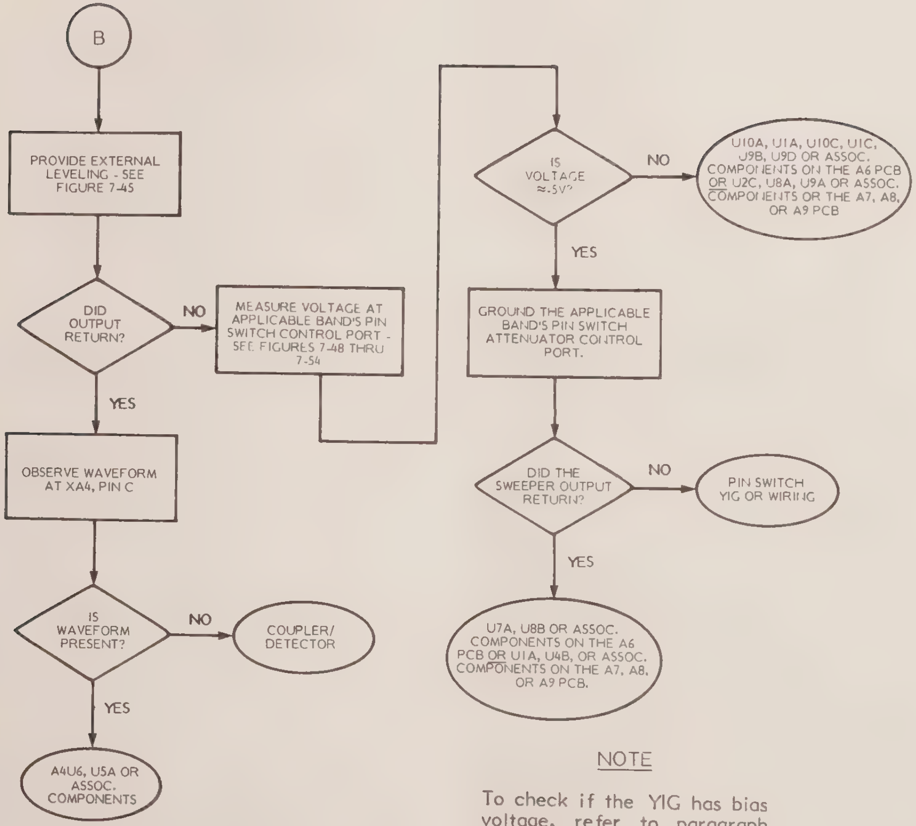

ERROR CODES 15/20
OBSERVE OUTPUT POWER ON 560 - SEE FIGURE 7-45.
IS OUTPUT PRESENT?
NO
A
YES
IS TRACE LEVEL ±1 dB?
YES
A4U11D OR ASSOCIATED COMPONENTS
NO
ARE ALL OTHER AVAILABLE ALC ERROR CODES PRESENT? (TABLE 7-15)
YES
A4/A6 CIRCUITRY - SEE FIGURE 7-48 & 7-55
NO
OBSERVE WAVEFORM AT XA4, PIN A
IS WAVEFORM PRESENT?
NO
DOWN CONVERTER OR WIRING
YES
ANY A4 OR A6 CIRCUITS FOR 6609 - A4U4, A4U5B OR ASSOCIATED COMPONENTS FOR ALL OTHER MODELS
ERROR CODES 16/20, 17/20, 18/20, 19/20
OBSERVE OUTPUT POWER ON 560 - SEE FIGURE 7-45
IS OUTPUT PRESENT?
NO
B
YES
IS TRACE LEVEL ±1 dB?
YES
A4U11D OR ASSOCIATED COMPONENTS
NO
ARE ALL OTHER AVAILABLE ALC ERROR CODES PRESENT? (TABLE 7-15)
NO
OBSERVE OUTPUT POWER WITH OSCILLOSCOPE
YES
OBSERVE WAVEFORM AT XA4-C
IS WAVEFORM PRESENT?
YES
A4/A6 CIRCUITRY - SEE FIGURES 7-48 & 7-55
NO
COUPLER/ DETECTOR
IN SERIES WITH A 1k RESISTOR, APPLY 5V TO THE APPLICABLE BAND'S PIN SWITCH ATTENUATOR CONTROL PORT SEE FIGURES 7-48 THRU 7-55 (+5V IS AVAILABLE AT XA4, PIN 26)
DID OUTPUT CHANGE?
NO
PIN SWITCH OR WIRING
YES
U7A, U8B, OR ASSOC. COMPONENTS ON THE A6 PCB OR U1A, U4B OR ASSOC. COMPONENTS ON THE A7, A8 OR A9 PCB.
ERROR CODE 20
IS ERROR CODE 21 ALSO PRESENT?
YES
TROUBLESHOOT ERROR CODE 21
NO
ARE THERE OTHER ALC ERROR CODES PRESENT?
YES
TROUBLESHOOT OTHER CODE(S)
NO
OBSERVE OUTPUT POWER ON 560 - SEE FIGURE 7-45
IS TRACE UNLEVEL > ±1 dB IN ANY ONE BAND?
NO
TROUBLESHOOT A4 PCB - SEE FIGURE 7-55
YES
TROUBLESHOOT THE UNLEVEL BAND. SEE FIGURES 7-48 – 7-54

Figure 7-47. ALC Loop Error Code Troubleshooting Flowchart (Sheet 1 of 2)


A
PROVIDE EXTERNAL LEVELING. SEE FIGURE 7-45.
DID OUTPUT RETURN?
NO
YES
CHECK VOLTAGE AT MOD 2 CONTROL PORT (FIGURES 7-48 - 7-54)
OBSERVE WAVEFORM AT XA4, PIN A
IS VOLTAGE ≈-5V?
YES
GROUND THE CONTROL PORT ON MOD I
NO
IS WAVEFORM PRESENT?
YES
A4U4 OR ASSOC. COMPONENTS
A6U10A, U1A, U10C, U1C, U9B, U9D OR ASSOC. COMPONENTS
DID SWEEPER OUTPUT RETURN?
NO
MOD I, YIG OR WIRING
NO
DOWN CONVERTER OR WIRING
YES
A6U7A/U8B OR ASSOC. COMPONENTS

NOTE

To check if the YIG has bias voltage, refer to paragraph 5-8.2.

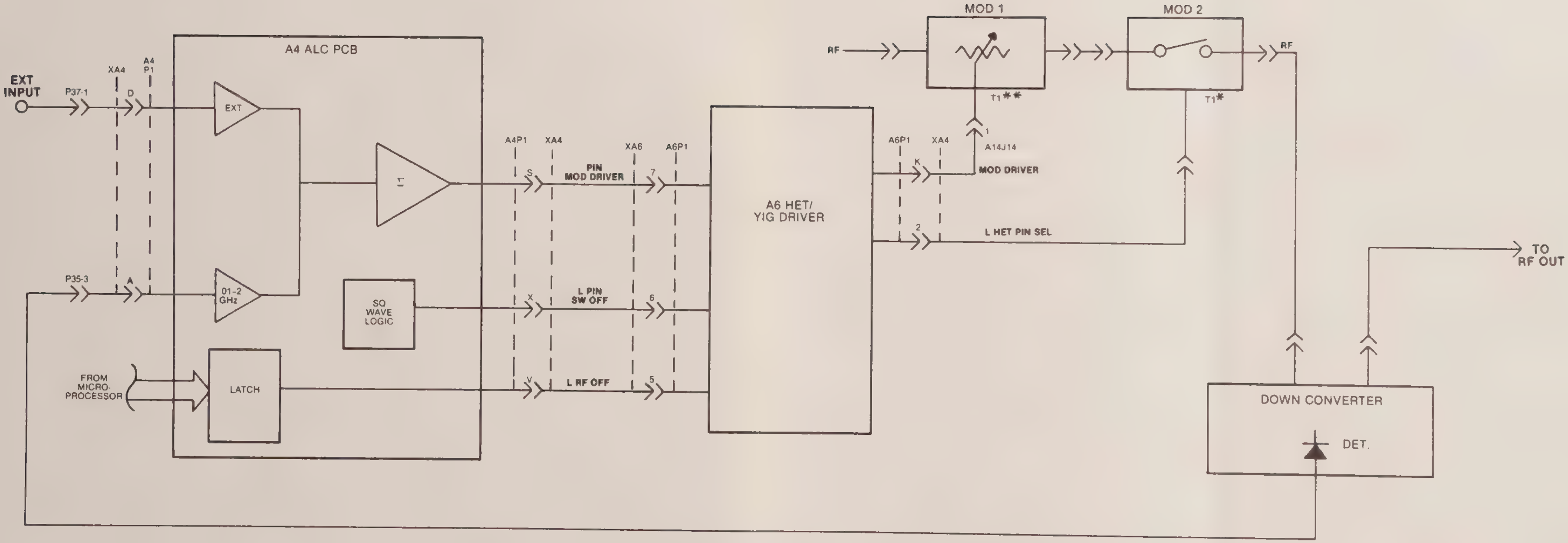

B
PROVIDE EXTERNAL LEVELING - SEE FIGURE 7-45
IS VOLTAGE ≈-5V?
NO
U10A, U1A, U10C, U1C, U9B, U9D OR ASSOC. COMPONENTS ON THE A6 PCB OR U2C, U8A, U9A OR ASSOC. COMPONENTS OR THE A7, A8, OR A9 PCB
YES
DID OUTPUT RETURN?
NO
MEASURE VOLTAGE AT APPLICABLE BAND'S PIN SWITCH CONTROL PORT - SEE FIGURES 7-48 THRU 7-54
GROUND THE APPLICABLE BAND'S PIN SWITCH ATTENUATOR CONTROL PORT.
YES
OBSERVE WAVEFORM AT XA4, PIN C
DID THE SWEEPER OUTPUT RETURN?
NO
PIN SWITCH YIG OR WIRING
YES
IS WAVEFORM PRESENT?
NO
COUPLER/ DETECTOR
U7A, U8B OR ASSOC. COMPONENTS ON THE A6 PCB OR U1A, U4B, OR ASSOC. COMPONENTS ON THE A7, A8, OR A9 PCB.
YES
A4U6, U5A OR ASSOC. COMPONENTS

NOTE

To check if the YIG has bias voltage, refer to paragraph 5-8.2.

Figure 7-47. ALC Loop Error Code Troubleshooting Flowchart (Sheet 2 of 2)

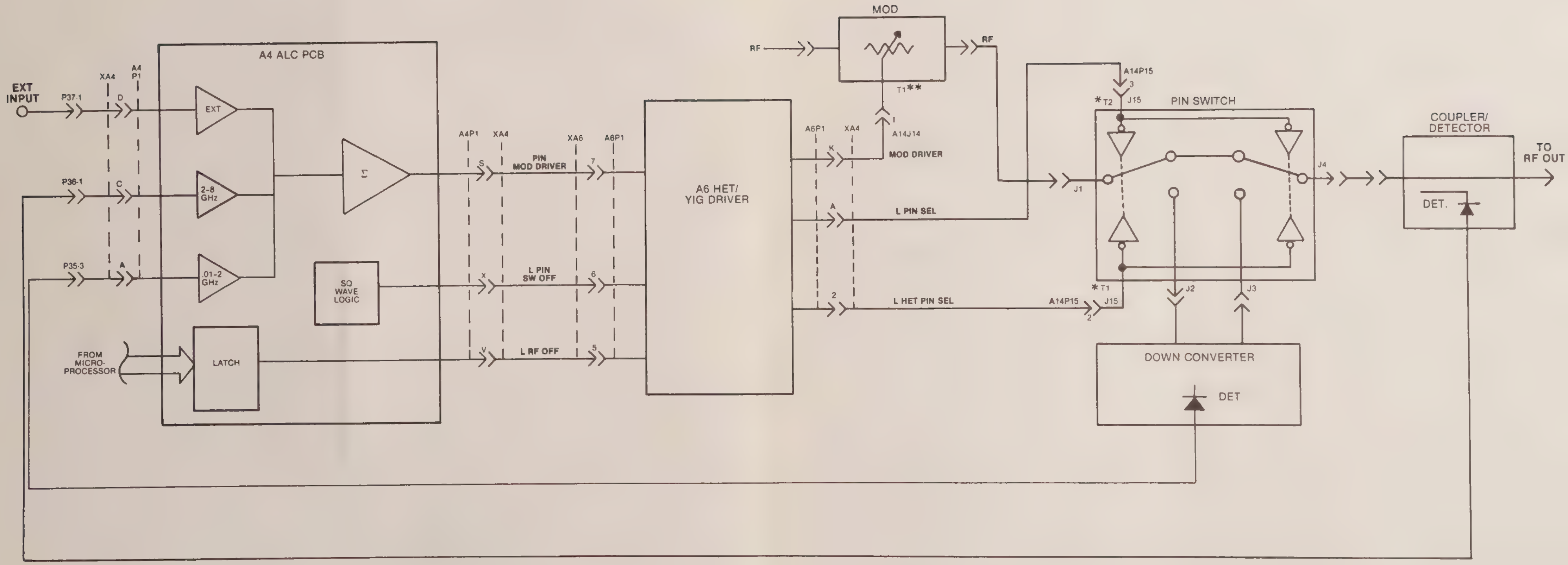
Figure 7-47Ⓐ.


EXT INPUT
P37-1
XA4
A4 P1
D
A4 ALC PCB
EXT
Σ
P35-3
A
01-2 GHz
SQ WAVE LOGIC
FROM MICRO-PROCESSOR
LATCH
A4P1
XA4
XA6
A6P1
S
PIN MOD DRIVER
7
X
L PIN SW OFF
6
V
L RF OFF
5
A6 HET/ YIG DRIVER
A6P1
XA4
K
2
A14J14
1
MOD DRIVER
L HET PIN SEL
RF
MOD 1
T1**
MOD 2
T1*
RF
TO RF OUT
DOWN CONVERTER
DET.

*Switch Control Port
**Attenuator Control Port

NOTE
To measure voltage at
the switch and attenuator
control ports, press RETRACE
RF to ON.

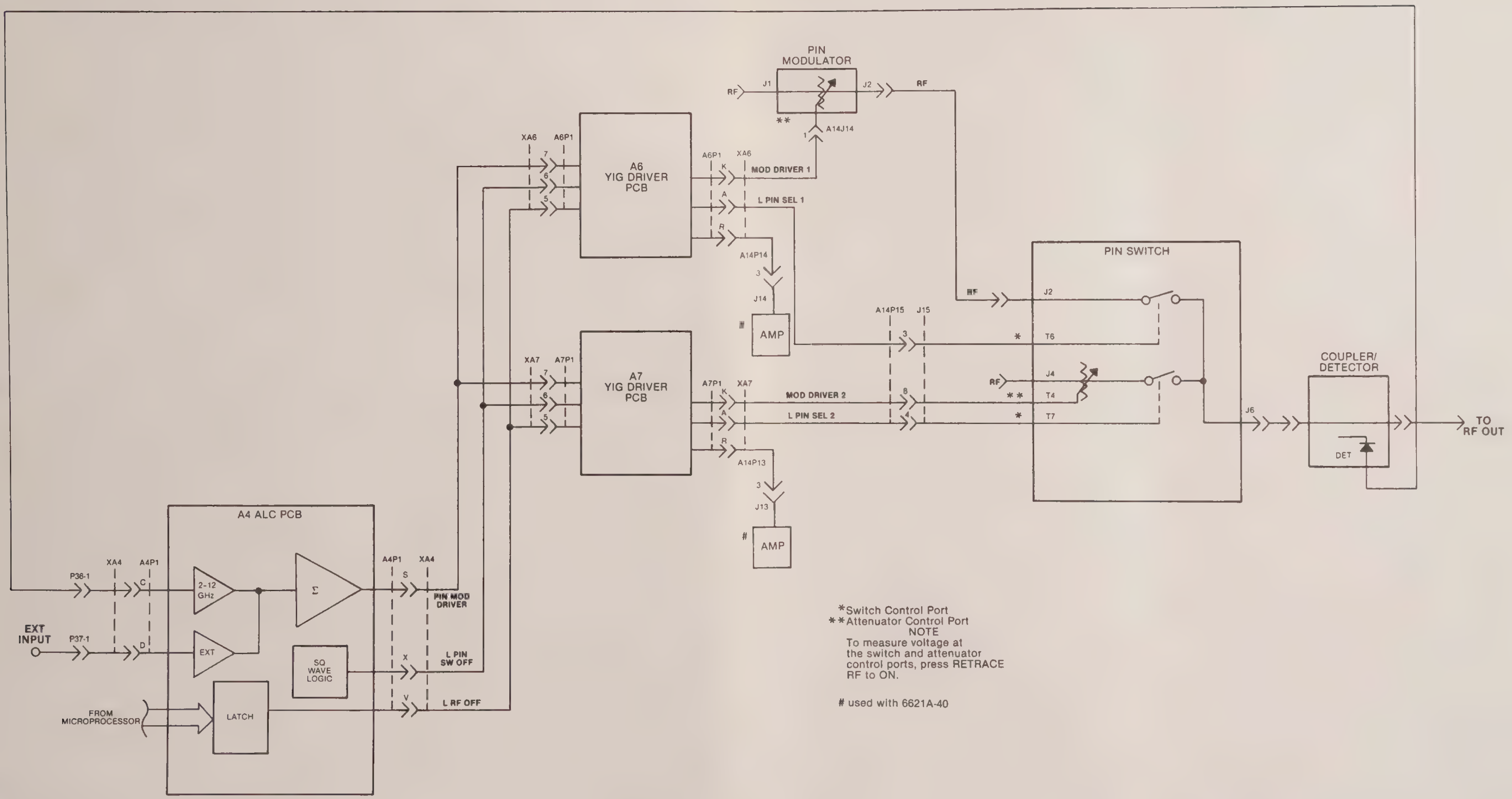
Figure 7-48. Model 6609A ALC Loop Troubleshooting Simplified Schematic


EXT INPUT
P37-1
XA4
A4 P1
D
P36-1
C
P35-3
A
A4 ALC PCB
EXT
2-8 GHz
.01-2 GHz
Σ
SQ WAVE LOGIC
FROM MICRO-PROCESSOR
LATCH
A4P1
XA4
XA6
A6P1
S
PIN MOD DRIVER
7
X
L PIN SW OFF
6
V
L RF OFF
5
A6 HET/ YIG DRIVER
MOD
RF
RF
T1**
A14J14
1
A6P1
XA4
K
MOD DRIVER
A
L PIN SEL
2
L HET PIN SEL
A14P15
3
*T2
J15
PIN SWITCH
J1
J4
*T1
J15
A14P15
2
J2
J3
DOWN CONVERTER
DET
COUPLER/ DETECTOR
DET.
TO RF OUT

*Switch Control Port
**Attenuator Control Port

NOTE
To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

Figure 7-49. Model 6617A ALC Loop Troubleshooting Simplified Schematic


PIN MODULATOR
RF
J1
J2
RF
**
1
A14J14
XA6
A6P1
7
6
5
A6 YIG DRIVER PCB
A6P1
XA6
K
MOD DRIVER 1
A
L PIN SEL 1
R
A14P14
3
J14
#
AMP
PIN SWITCH
RF
J2
A14P15
J15
3
*
T6
RF
J4
**
T4
*
T7
8
4
XA7
A7P1
7
6
5
A7 YIG DRIVER PCB
A7P1
XA7
K
MOD DRIVER 2
A
L PIN SEL 2
R
A14P13
3
J13
#
AMP
COUPLER/ DETECTOR
J6
DET
TO RF OUT
A4 ALC PCB
XA4
A4P1
P36-1
C
2-12 GHz
Σ
A4P1
XA4
S
PIN MOD DRIVER
EXT INPUT
P37-1
D
EXT
SQ WAVE LOGIC
X
L PIN SW OFF
FROM MICROPROCESSOR
LATCH
V
L RF OFF

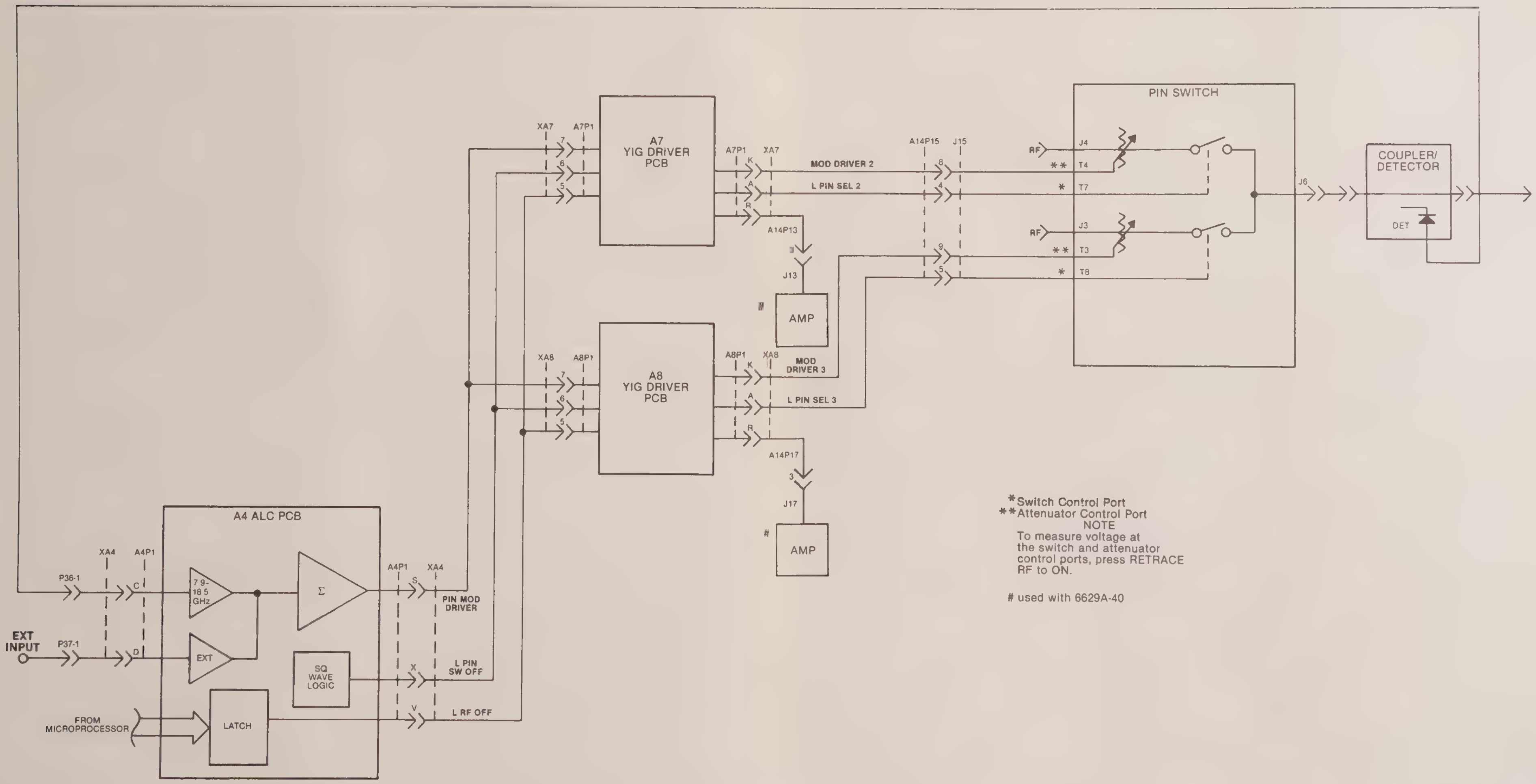
*Switch Control Port
**Attenuator Control Port

NOTE

To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

used with 6621A-40

Figure 7-50. 6621A/6621A-40 ALC Loop Troubleshooting Simplified Schematic


PIN SWITCH
XA7
A7P1
7
6
5
A7
YIG DRIVER
PCB
A7P1
XA7
K
A
R
MOD DRIVER 2
L PIN SEL 2
A14P15
J15
8
4
9
5
RF
J4
**
T4
*
T7
RF
J3
**
T3
*
T8
J6
COUPLER/
DETECTOR
DET
A14P13
J13
#
AMP
XA8
A8P1
A8
YIG DRIVER
PCB
A8P1
XA8
K
A
R
MOD
DRIVER 3
L PIN SEL 3
A14P17
3
J17
#
AMP
A4 ALC PCB
XA4
A4P1
P36-1
C
EXT
INPUT
P37-1
D
7.9-
18.5
GHz
EXT
Σ
SQ
WAVE
LOGIC
FROM
MICROPROCESSOR
LATCH
A4P1
XA4
S
PIN MOD
DRIVER
X
L PIN
SW OFF
V
L RF OFF

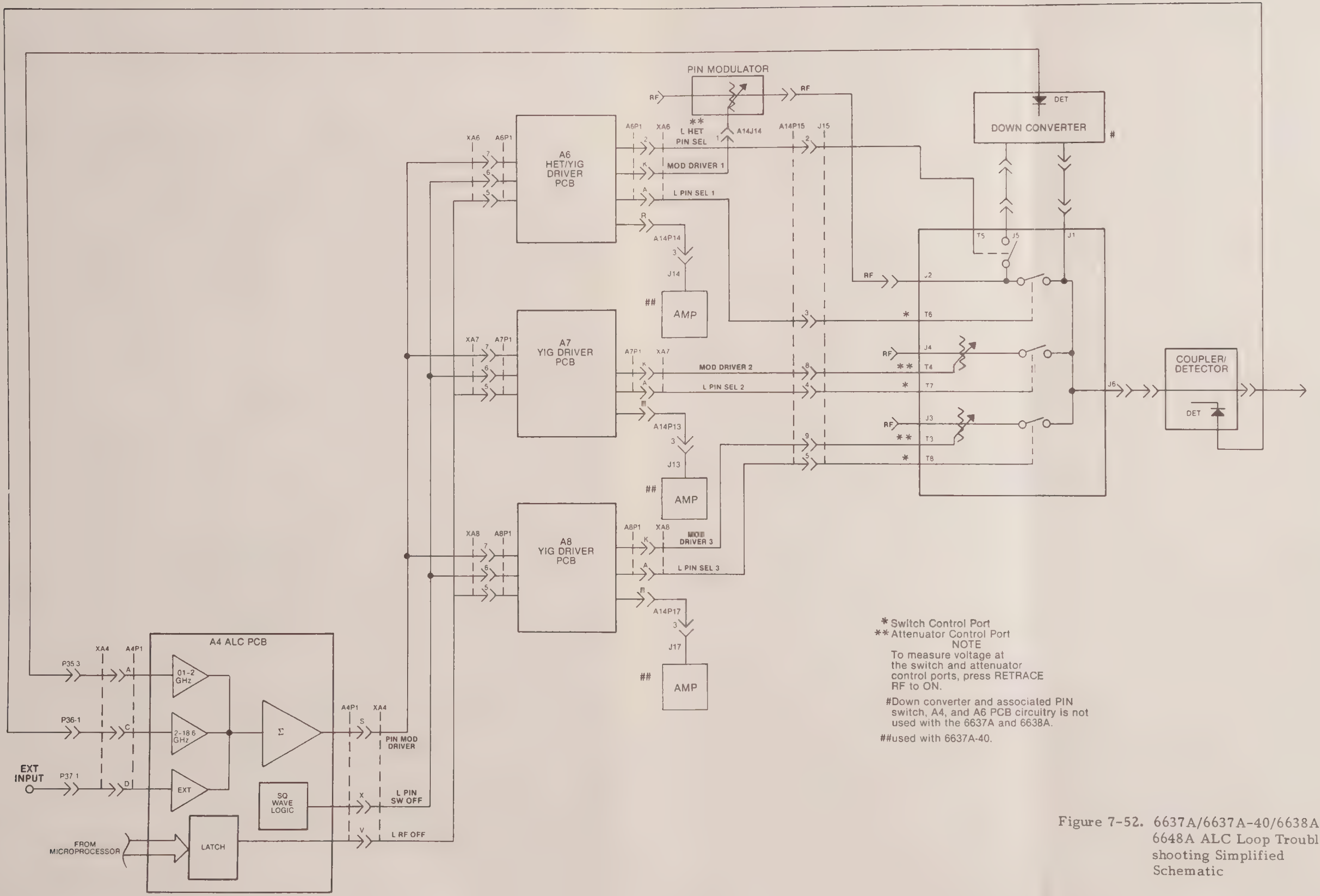
*Switch Control Port
**Attenuator Control Port

NOTE

To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

# used with 6629A-40

Figure 7-51. 6629A/6629A-40 ALC Loop Troubleshooting Simplified Schematic


PIN MODULATOR
RF
RF
DET
DOWN CONVERTER
#
**
L HET
PIN SEL
A14J14
MOD DRIVER 1
L PIN SEL 1
A6P1
XA6
A14P15
J15
A6
HET/YIG
DRIVER
PCB
A14P14
J14
##
AMP
T5
J5
J1
RF
J2
* T6
RF J4
** T4
* T7
RF J3
** T3
* T8
J6
COUPLER/
DETECTOR
DET
A7
YIG DRIVER
PCB
XA7
A7P1
MOD DRIVER 2
L PIN SEL 2
A14P13
J13
##
AMP
A8
YIG DRIVER
PCB
XA8
A8P1
MOD
DRIVER 3
L PIN SEL 3
A14P17
J17
##
AMP
A4 ALC PCB
XA4
A4P1
P35 3
P36-1
EXT
INPUT
P37 1
01-2
GHz
2-18 6
GHz
EXT
Σ
SQ
WAVE
LOGIC
LATCH
FROM
MICROPROCESSOR
PIN MOD
DRIVER
L PIN
SW OFF
L RF OFF

* Switch Control Port

** Attenuator Control Port

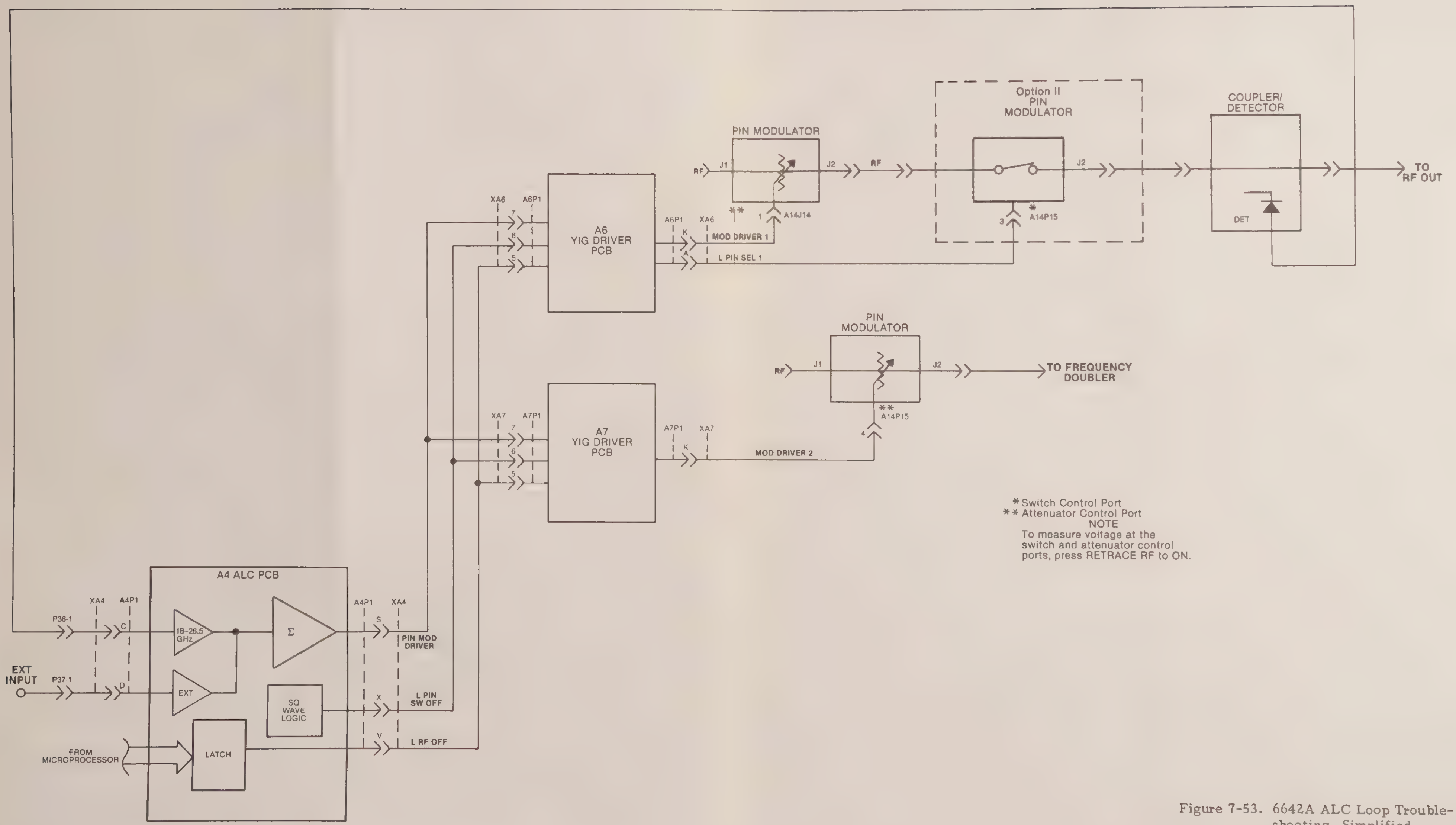
NOTE

To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

#Down converter and associated PIN switch, A4, and A6 PCB circuitry is not used with the 6637A and 6638A.

##used with 6637A-40.

Figure 7-52. 6637A/6637A-40/6638A/6647A/6648A ALC Loop Troubleshooting Simplified Schematic

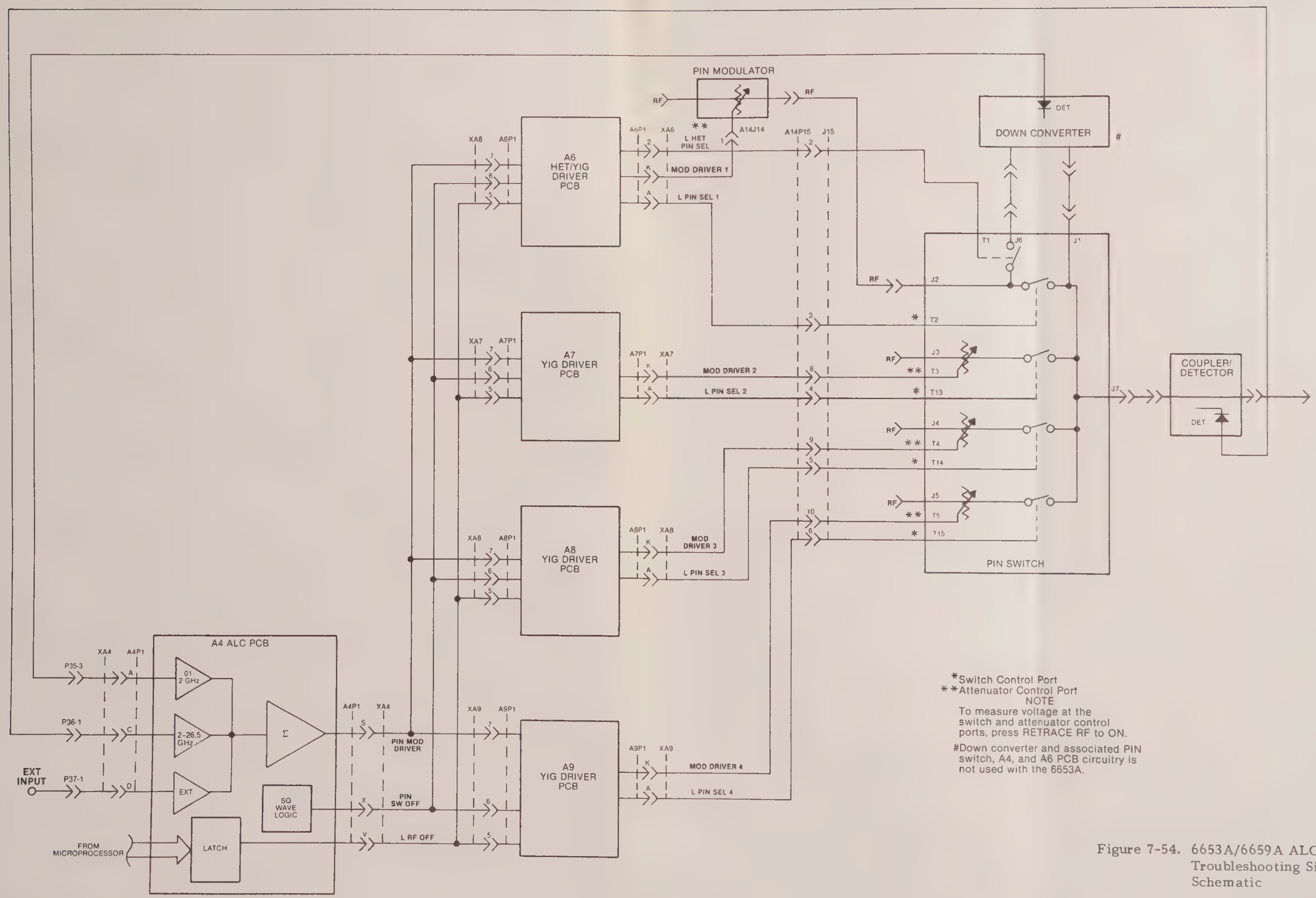

PIN MODULATOR
Option II
PIN
MODULATOR
COUPLER/
DETECTOR
RF
J1
J2
RF
J2
TO
RF OUT
DET
**
1
A14J14
*
3
A14P15
XA6
A6P1
7
6
5
A6
YIG DRIVER
PCB
A6P1
XA6
K
A
MOD DRIVER 1
L PIN SEL 1
PIN
MODULATOR
RF
J1
J2
TO FREQUENCY
DOUBLER
**
A14P15
4
XA7
A7P1
7
6
5
A7
YIG DRIVER
PCB
A7P1
XA7
K
MOD DRIVER 2
A4 ALC PCB
XA4
A4P1
P36-1
C
18-26.5
GHz
Σ
EXT
INPUT
P37-1
D
EXT
SQ
WAVE
LOGIC
FROM
MICROPROCESSOR
LATCH
A4P1
XA4
S
PIN MOD
DRIVER
X
L PIN
SW OFF
V
L RF OFF

* Switch Control Port
** Attenuator Control Port

NOTE

To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

Figure 7-53. 6642A ALC Loop Troubleshooting Simplified Schematic


PIN MODULATOR
RF
RF
DET
DOWN CONVERTER
#
XA6
A6P1
A6
HET/YIG
DRIVER
PCB
A6P1
XA6
L HET
PIN SEL
MOD DRIVER 1
L PIN SEL 1
A14J14
A14P15
J15
T1
J6
J1
RF
J2
T2
XA7
A7P1
A7
YIG DRIVER
PCB
A7P1
XA7
MOD DRIVER 2
L PIN SEL 2
J3
T3
T13
J4
T4
T14
J5
T5
T15
J7
COUPLER/
DETECTOR
DET
XA8
A8P1
A8
YIG DRIVER
PCB
A8P1
XA8
MOD
DRIVER 3
L PIN SEL 3
PIN SWITCH
A4 ALC PCB
XA4
A4P1
P35-3
P36-1
P37-1
EXT
INPUT
01
2 GHz
2-26.5
GHz
EXT
Σ
SQ
WAVE
LOGIC
LATCH
FROM
MICROPROCESSOR
A4P1
XA4
PIN MOD
DRIVER
PIN
SW OFF
L RF OFF
XA9
A9P1
A9
YIG DRIVER
PCB
A9P1
XA9
MOD DRIVER 4
L PIN SEL 4

*Switch Control Port
**Attenuator Control Port

NOTE

To measure voltage at the switch and attenuator control ports, press RETRACE RF to ON.

#Down converter and associated PIN switch, A4, and A6 PCB circuitry is not used with the 6653A.

Figure 7-54. 6653A/6659A ALC Loop Troubleshooting Simplified Schematic

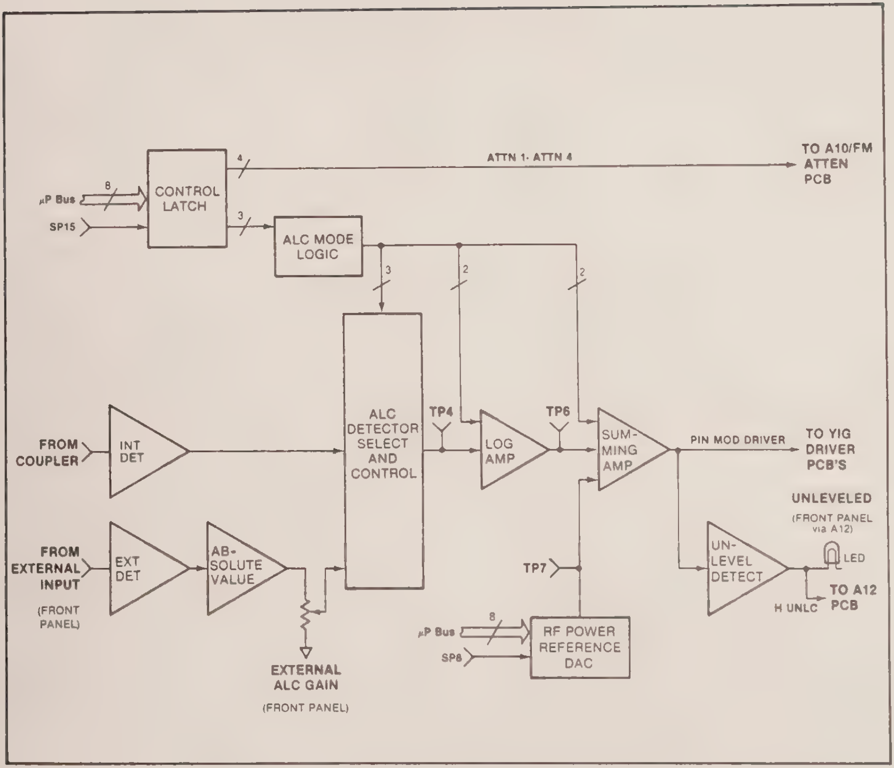
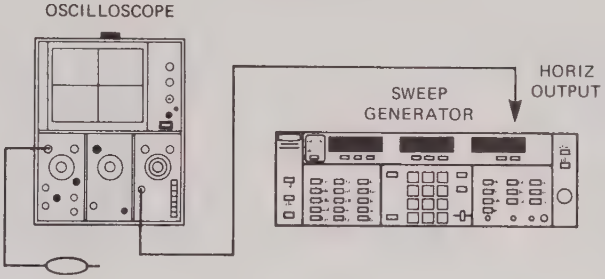

μP Bus
8
SP15
CONTROL LATCH
4
ATTN 1- ATTN 4
TO A10/FM ATTEN PCB
3
ALC MODE LOGIC
3
2
2
FROM COUPLER
INT DET
ALC DETECTOR SELECT AND CONTROL
TP4
LOG AMP
TP6
SUM-MING AMP
PIN MOD DRIVER
TO YIG DRIVER PCB'S
UNLEVELED
(FRONT PANEL via A12)
LED
UN-LEVEL DETECT
H UNLC
TO A12 PCB
FROM EXTERNAL INPUT
(FRONT PANEL)
EXT DET
AB-SOLUTE VALUE
EXTERNAL ALC GAIN
(FRONT PANEL)
TP7
μP Bus
8
SP8
RF POWER REFERENCE DAC

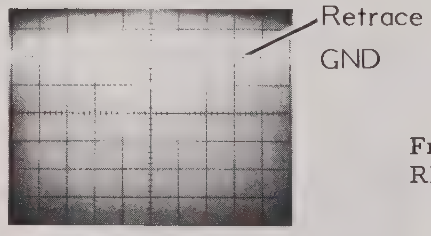
Figure 7-55. Error Code 20 Troubleshooting Block Diagram

TEST EQUIPMENT SETUP

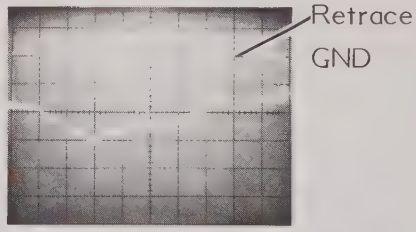

OSCILLOSCOPE
SWEEP GENERATOR
HORIZ OUTPUT

MODEL 720 DETECTOR OUTPUT

LEVELED


Retrace
GND

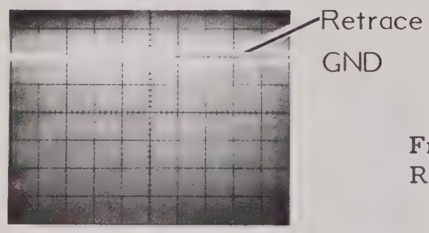
UNLEVELED*


Retrace
GND

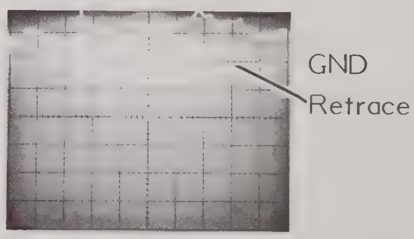
Frequency: .01 - 2 GHz
RF Power: 5 dBm

A4TP4

LEVELED


Retrace
GND

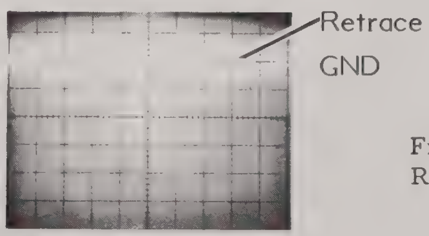
UNLEVELED*


GND
Retrace

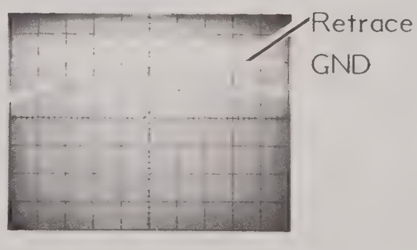
Frequency: .01 - 8 GHz
RF Power: 5 dBm

COUPLER OUTPUT

LEVELED


Retrace
GND

UNLEVELED*


Retrace
GND

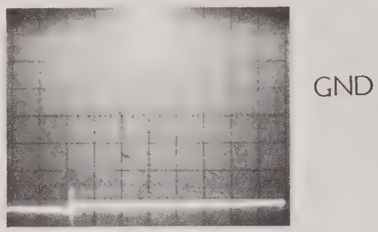
Frequency: 2 - 8 GHz
RF Power: 5 dBm

* Unleveled output simulated by disabling A4P1, pin S.

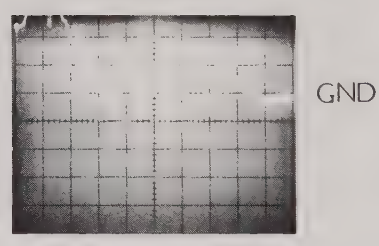
Figure 7-56. ALC Loop Waveforms

A4TP6

LEVELED



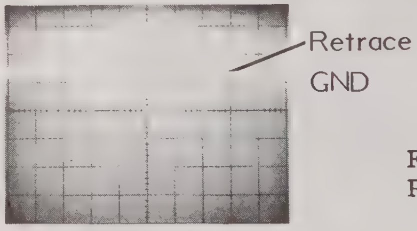
UNLEVELED*



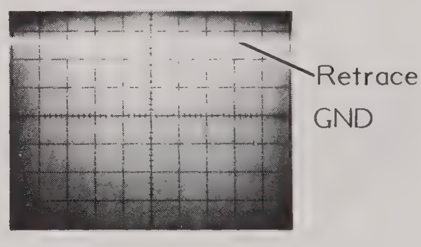
Frequency: .01 - 8 GHz
RF Power: 5 dBm

A6P1, Pin K

LEVELED



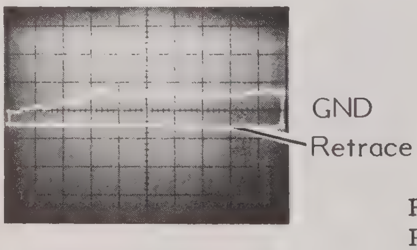
UNLEVELED**



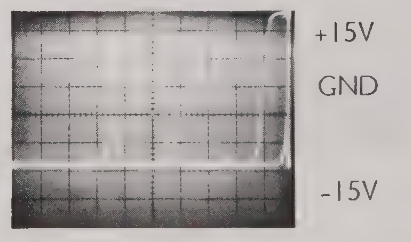
Frequency: .01 - 8 GHz
RF Power: 5 dBm

A4P1, Pin S

LEVELED



UNLEVELED*



Frequency: .01 - 8 GHz
RF Power: 5 dBm

NOTE

The unleveled waveform shown is an example of one that could appear at pin S. The Level Amplifier (U24) could also be latched at either rail, in which case the waveform could be a straight line (dc voltage), appearing at either +15V or -15V.

* Unleveled output simulated by disabling A4P1, pin S.

** Unleveled output simulated by disabling A6P1, pin K.

Figure 7-56. ALC Loop Waveforms (Continued)

Table 7-16. RF Components, Specification Data

YIG-TUNED OSCILLATORS

FREQUENCY (GHz)	WILTRON PART NO.	MINIMUM POWER mW	dBm
18 - 36.5	1005-35	10.0	10.0[1]
13.25 - 20	1005-40	20.0	13.0[2]
4.6 - 6.6	1005-45	3.2	5.0
12.4 - 18.6	1005-51	30.2	14.8
12.4 - 20	1005-52	50.0	17.0[3]
8 - 12.4	1005-53 or -54	45.0	16.5
12.4 - 18.0	1005-55 or -59	45.0	16.5
18 - 26.5	1005-61	20.0	13.0

[1] +8 dBm (6.4 mW) from 17.8 to 26.7 GHz.
[2] +17 dBm (15.0 mW) from 12.3 to 18.5 GHz.
[3] 16 dBm (40.0 mW) from 18.5 to 20 GHz.

RF COMPONENTS

COMPONENT	WILTRON PART NO.	FREQUENCY (GHz)	SPECIFICATION (Max.)
Isolators	All	All	Insertion Loss: 0.5 dB
Low Pass Filters	1030-26 1030-21	2 - 8 2 - 18.7	Insertion Loss: 0.5 dB 0 to 10 GHz; 0.6 dB 10.1 to 22 GHz
Low Pass Filters	All Others	—	Insertion Loss: 0.5 to 10 GHz; 0.55 dB to 18.7 GHz
PIN Switch, DPDT	660-B-8149	.01 - 8	Insertion Loss: 2 dB
PIN Switch, 4-Port	660-C-8821	.01 - 20	Insertion Loss @ Ic = 0 .01 -2 GHz Port - 1.5 2 - 8 GHz Port - 2.5 dB 8 - 12.4 GHz Port - 2. 12.4 - 20 GHz Port - 3.
PIN Switch, 5-Port	660-D-11745	.01 - 26.5	Insertion Loss @ Ic = 0 .01 -2 GHz Port - 2.0 2 - 8 GHz Port - 3.0 8 - 12.4 GHz Port - 2 12 - 18.5 GHz Port - 3 18 - 26.6 GHz Port - 4
Directional Coupler	660-C-8657	2 - 18.6	Insertion Loss: 1 ±0 Sensitivity: ±0.4 dB
Directional Coupler	660-B-8125-2	2 - 26.5	Insertion Loss: <1 dB
Modulator	660-C-9342	2 - 8	Insertion Loss @ Ic = 0 1.5 dB
Down Converter	660-D-9157	.01 - 2	Output Power: +13 dB for -8 dBm input

7-12 A5 FREQUENCY INSTRUCTION AND A6-A9 YIG DRIVER PCBs

7-12.1 A5 Frequency Instruction PCB, Circuit Description

The A5 Frequency Instruction PCB provides YIG oscillator tuning voltages to the A6, A7, A8 and A9 YIG Driver PCBs, plus a narrow (≤50 MHz) sweep-tuning-voltage ramp to the A10 FM/Attenuator PCB. The A5 PCB also supplies a regulated +10V bandswitch-reference voltage to the A6-A9 YIG Driver PCBs, and an RF Slope control voltage to the A12 Microprocessor PCB. A functional block diagram of the A5 PCB is shown in Figure 7-57 and the schematic (2 sheets) is shown in Figure 7-58.

The three main YIG tuning voltages supplied by the A5 PCB (Figure 7-57) are the **F CEN**, **ΔF >50 MHz**, and **F CORR** signals. These three signals are summed together at the YIG Driver PCBs and used to generate the YIG oscillator tuning current.

The **F CEN** signal is the output of the Center Frequency digital-to-analog converter (DAC) circuit (U7, U6). The input to this circuit is a 16-bit group from the microprocessor representing one of the following:

- the center frequency in a FULL, F1-F2, or M1-M2 sweep,
- the F0 frequency in a ΔF F0 sweep,
- the F1 frequency in a ΔF F1 sweep, or
- the selected CW F0, CW F1, CW F2, CW M1, or CW M2 frequency.

The two 8-bit words constituting the center-frequency-control group are applied to the FCEN DAC (U7) via FCEN Latches 1, 2, and 3. Word #1 (the MS word) is loaded into latch #2 (U9) when the microprocessor clocks **SP0** HIGH. Word #2 (the LS word) is loaded into latch #1 (U8) when **SP1** is clocked HIGH. Coincident with word #2 being clocked thru latch #1, word #1 is clocked thru latch #3. This latching arrangement allows all 16 bits of the center-frequency-control group to be simultaneously applied to the FCEN DAC. The other A5 PCB input affecting the **F CEN** signal line is **FREQ OFFSET.** This line is only active when the sweep generator is part of a Model 661 Tracking Sweeper Controller System. At that time, the voltage present on this line offsets the **F CEN** signal, as determined by the tracking sweeper controller.

The **ΔF >50 MHz** signal is the output from the Sweep Width (ΔF) DAC (U24). The U24 circuit is a multiplier DAC that scales the analog REF input by a factor of N/4095. The circuit gain is from 0 to 1 and the resolution is $1 \div 2^{12}$ ($1 \div 4096$). The digital input to U24 is a 12-bit group from the microprocessor representing one of the following:

- the sweep width in a FULL, F1-F2, or M1-M2 sweep,
- the ΔF value in a ΔF F0 or ΔF F1 sweep, or
- a zero value in any of the five CW frequency modes.

The input digital group is loaded into the two ΔF Latches (U17, U18) when the microprocessor clocks **SP6** and **SP7** HIGH.

The analog REF input to the Sweep Width (ΔF) DAC (U24) is a 10-volt signal (-5V to +5V) from the Sweep Sel Switch (U22A, U22B, U22C), via the -5V Offset circuit (U23). The inputs to the Sweep Sel Switch are a 0-10V manual tuning voltage from the front panel MANUAL SWEEP control, a 0-10V ramp from the A2 Ramp Generator PCB, or a 0-10V step-frequency tuning voltage from the Step Freq DAC (U19). The input to this DAC is a 12-bit group from the microprocessor that is generated in response to GPIB bus commands (paragraph 3-7.2). This 12-bit group is formed using two 8-bit words (the remaining 4-bits in word #1 are used to (1) control the Sweep Sel Switch and (2) provide an input for the CW Filter Current Driver circuit). Word #1 (the MS word) is loaded into latch #2 (U16) when the microprocessor clocks **SP4** HIGH. Word #2 (the LS word) is loaded into latch #1 (U15) when **SP3** is clocked HIGH. Coincident with word #2 being clocked thru latch #1, word #1 is clocked thru latch #3 (U31). This latching arrangement allows all 12 bits of the step-frequency-control group to be simultaneously applied to the Step Freq DAC.

The output of the Sweep Width DAC is applied to the W/M/N Switch (U28A, U28B, U28C, U28D). This switch is controlled by the microprocessor, via the ΔF Latch 2 circuit. The W/M/N switch is used to select a wide (>1000 MHz), medium (51 to 1000 MHz), or narrow (≤50 MHz) sweep width. If the microprocessor has selected a wide sweep width, the DAC output is applied to the output circuit via the Buffer (U26). If the medium sweep width has been selected, the DAC output is scaled down by the ÷16 resistor (R37) before being applied to the output circuit. And if the narrow sweep width has been selected, the DAC output is applied to the Diff Amp circuit (U10B). This circuit cancels any common-mode signals existing between the analog ground on the A5 PCB and the analog ground on the A10 PCB. The output of the Diff Amp is applied to the A10 PCB via the **ΔF ≤50 MHz** signal line.

The **F CORR** signal is the output from the I/E (current to voltage) Converter circuit (U3). The input to this circuit is the sum of the current outputs from the ROM Lin DAC, the Freq Ver DAC, and the Freq Overlap circuit.

The ROM Lin DAC (U2) provides a linearity-correction frequency for the YIG oscillator. The input to this DAC is from the linearizer ROM on either the A6, A7, A8, or A9 PCB, depending on which YIG oscillator band is presently in use. The purpose of this linearizing ROM is to store data that will correct for nonlinear frequency characteristics in the YIG oscillator. The stored data provides the YIG oscillator with a frequency correction of up to ±64 MHz.

The Freq Ver DAC (U4) provides a vernier-correction frequency for the YIG oscillator. The input to this DAC is an 8-bit group from the microprocessor representing the front panel FREQUENCY VERNIER control-group output. This word is latched into the Freq Ver Latch (U5) when the microprocessor clocks **SP 2** HIGH. The Freq Ver DAC output provides the YIG oscillator with a frequency correction of up to ±12.7 MHz.

The Freq Overlap circuit (U33A-U33D, U34A-U34D, U35A, U35D) provides a 20 MHz frequency overlap between bands during a >200 MHz frequency sweep. This frequency overlap prevents frequency gaps from occurring due to the ±10 MHz accuracy of the YIG oscillators. There are five control inputs to this switching circuit, in addition to the **FCEN/VPF** signal that provides the frequency-overlap-tuning voltage. Four of the inputs are from the A6-A8 YIG Driver PCBs. These inputs select the resistor values needed to scale the **FCEN/VPF** ramp down to the correct frequency-overlap value. The fifth control input, **L >200 MHz**, determines when the circuit will be activated. For ΔF values greater than 200 MHz, the circuit is switched into the **F CORR** line circuitry; for ΔF values ≤200 MHz, the circuit is not active.

When no frequency correction is needed, the **F CORR** signal is 0 volts. If no linearity correction is required, the Lin ROM DAC input is 01111111 (0 = most significant bit). (There may be cases where a YIG oscillator requires no linearity correction. In such cases, no linearizing ROM is supplied and the U2 input resistors (Figure 7-58) provide the 01111111 input.) If no frequency vernier correction has been programmed for the selected frequency parameter (paragraph 3-2.2c), 01111111 is also clocked into the Freq Ver Latch. When the output currents of the two frequency-correction DACs are summed with the equal-but-opposite current from R4, and if no frequency overlap voltage is applied, the I/E Converter outputs 0 volts.

The other signals generated on the A5 PCB are the **FCEN/VPF**, **V/GHz**, **RAMP OUT**, **CW FILTER**, **L CW** Mode, and **RF Slope** control.

The **FCEN/VPF** signal is from the FCEN/VPF switch. The inputs to this switch are **F CEN** and the sum of **F CEN** and either **ΔF >50 MHz** or **ΔF ≤50 MHz**. If the sweep width is ≤200 MHz, the **F CEN** signal is switched onto the **FCEN/VPF** line. This line is used on the A6 thru A9 YIG Driver PCBs to control oscillator bandswitching. If the sweep width is 200 MHz or less, bandswitch is inhibited. Control for the FCEN/VPF switch is from the microprocessor, via the ΔF Latch 2 circuit.

The **V/GHz** signal is the sum of the **F CEN** and either the **ΔF >50 MHz** or the **ΔF≤50MHz** signals. The two signals are summed at the

FCEN/VPF Sum circuit (U14) and applied to the V/GHz Amp (U12). At U12, the output of the sum circuit is scaled so that the amplitude of the output ramp is 1V/GHz for all models except the 6642A, 6653A, and 6659A; in these models it is 0.5V/GHz. This output is applied to the rear panel 1V/GHz OUTPUT connector.

The **RAMP OUT** signal is from the +5V Offset circuit (U21A). This circuit restores the frequency tuning voltage to its original 0 to 10V state. The **RAMP OUT** signal is applied to the A3 Marker Generator PCB, where it is buffered and applied to the rear panel HORIZ OUTPUT connector.

The **CW FILTER** signal is from the CW Filter Current Driver circuit (Q1). The input to this circuit is from the microprocessor, via the Step Freq Latch 2 circuit. The CW Filter Current Driver converts the latch-output voltage to a current, which is used to drive the CW filter relay on the A6, A7, A8, and A9 YIG Driver PCBs.

The **L CW MODE** signal is created by ANDing together the three ΔF Latch 2 signals that control the W/M/N Switch. Only in a CW mode are all three of these signals HIGH simultaneously. The **L CW MODE** signal is applied to the A4 PCB.

The **RF SLOPE CONTROL** signal is from the Offset Amplifier circuit (U35B, U35C). This signal applies a model-dependent offset voltage to the front panel RF Slope control circuitry on the A12 Microprocessor PCB.

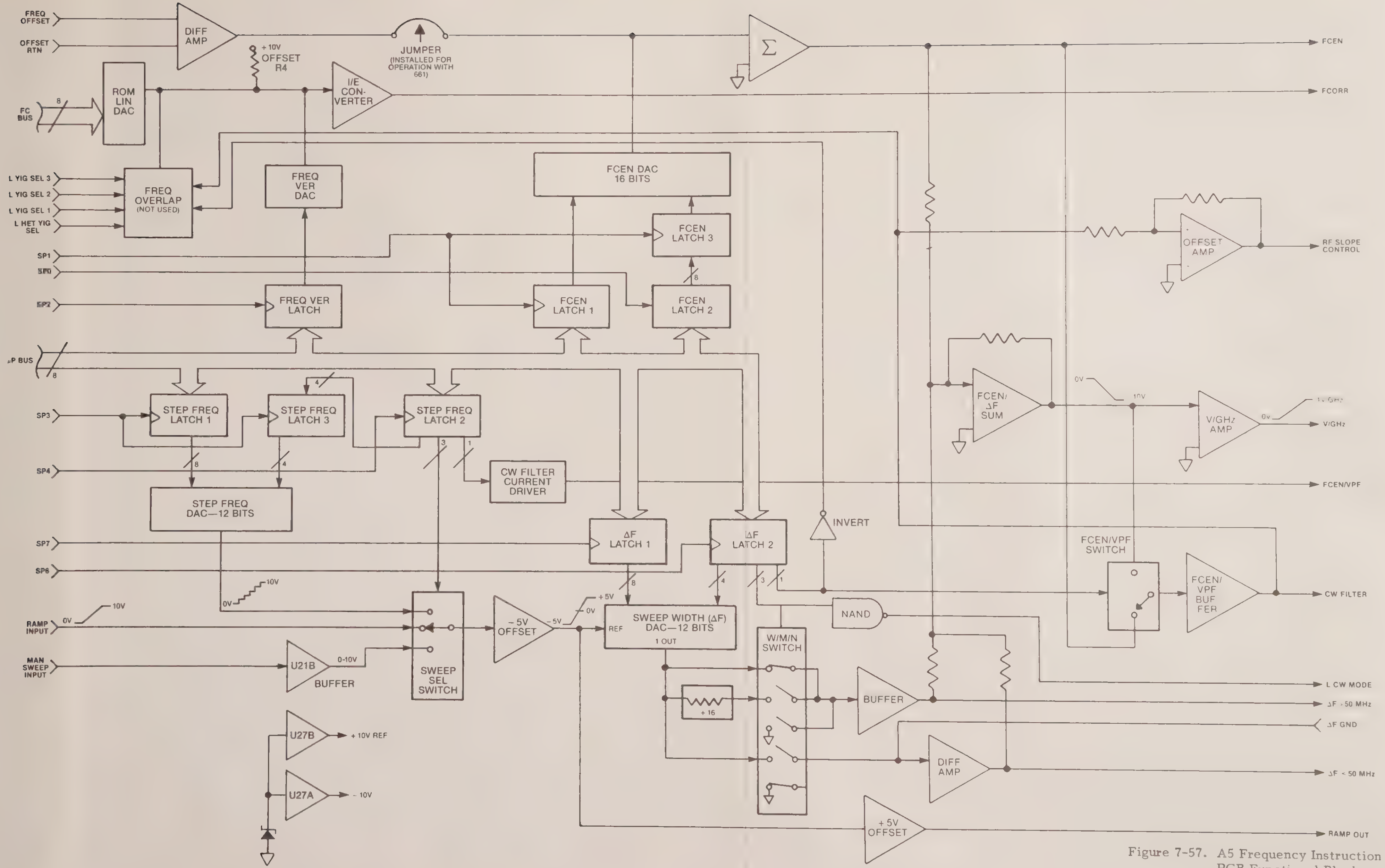

FREQ OFFSET
OFFSET RTN
DIFF AMP
+10V
OFFSET R4
JUMPER (INSTALLED FOR OPERATION WITH 661)
Σ
FCEN
FC BUS
8
ROM LIN DAC
I/E CON-VERTER
FCORR
L YIG SEL 3
L YIG SEL 2
L YIG SEL 1
L HET YIG SEL
FREQ OVERLAP (NOT USED)
FREQ VER DAC
FCEN DAC 16 BITS
FCEN LATCH 3
OFFSET AMP
RF SLOPE CONTROL
SP1
SP0
SP2
FREQ VER LATCH
FCEN LATCH 1
FCEN LATCH 2
μP BUS
8
FCEN/ ΔF SUM
0V
10V
V/GHz AMP
0v
1v/GHz
V/GHz
SP3
STEP FREQ LATCH 1
STEP FREQ LATCH 3
STEP FREQ LATCH 2
4
SP4
8
4
3
1
CW FILTER CURRENT DRIVER
FCEN/VPF
STEP FREQ DAC—12 BITS
INVERT
SP7
ΔF LATCH 1
ΔF LATCH 2
SP6
FCEN/VPF SWITCH
FCEN/ VPF BUF FER
CW FILTER
10V
0V
8
4
3
1
RAMP INPUT
0V
10V
+5V
−5V
0V
−5V OFFSET
REF
SWEEP WIDTH (ΔF) DAC—12 BITS
1 OUT
NAND
W/M/N SWITCH
MAN SWEEP INPUT
U21B
0-10V
BUFFER
SWEEP SEL SWITCH
÷16
BUFFER
L CW MODE
ΔF >50 MHz
ΔF GND
U27B
+10V REF
DIFF AMP
ΔF < 50 MHz
U27A
−10V
+5V OFFSET
RAMP OUT

Figure 7-57. A5 Frequency Instruction PCB Functional Block Diagram

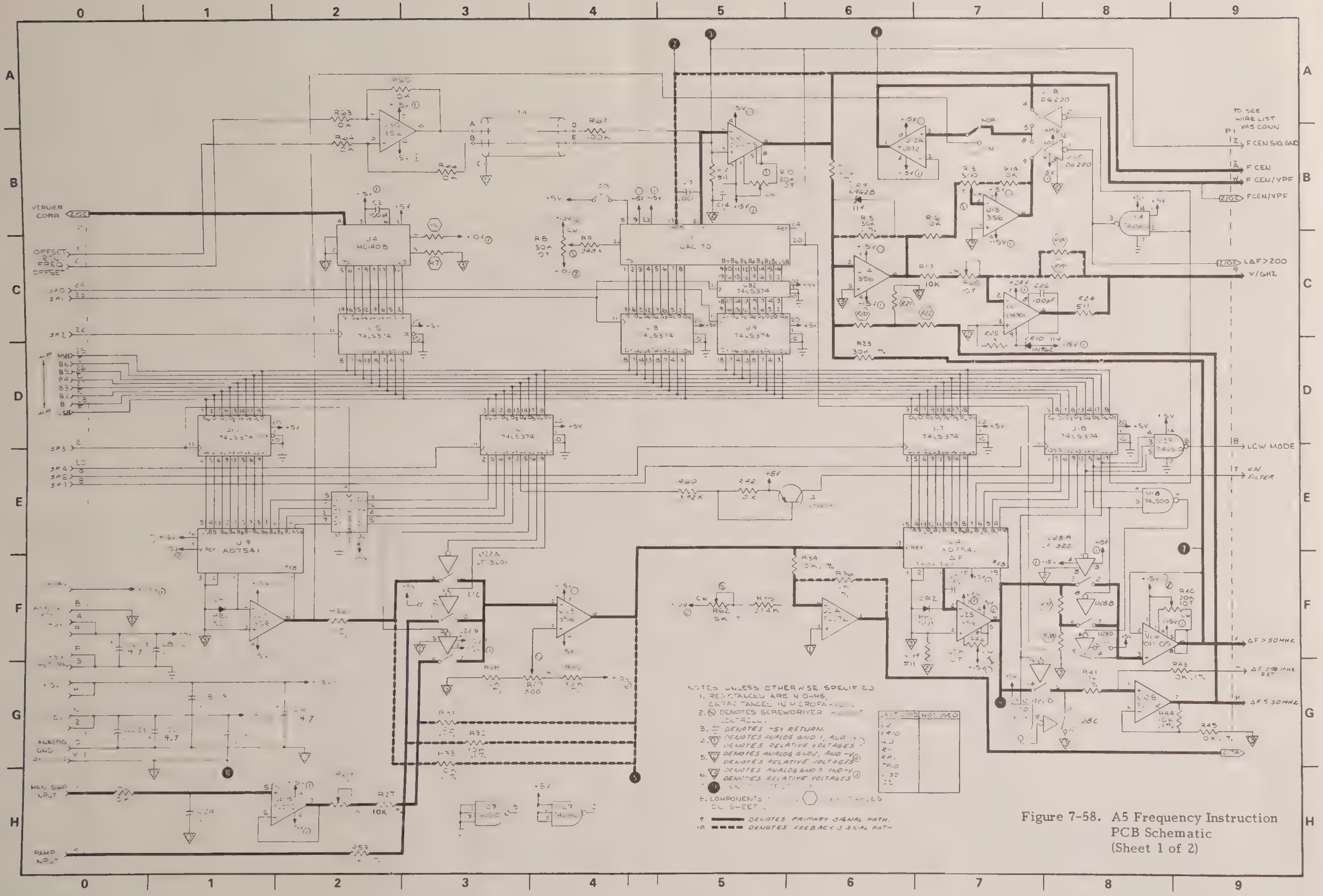
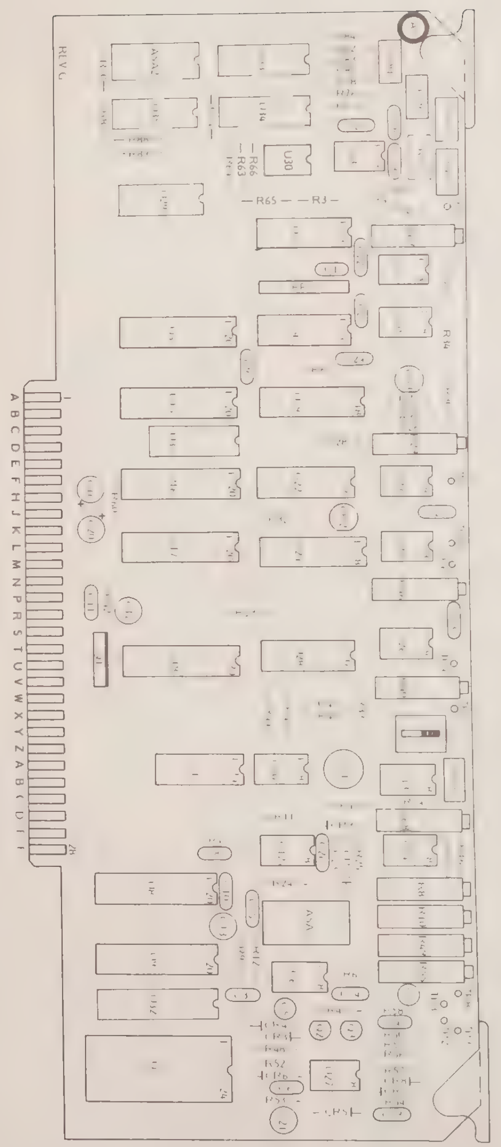
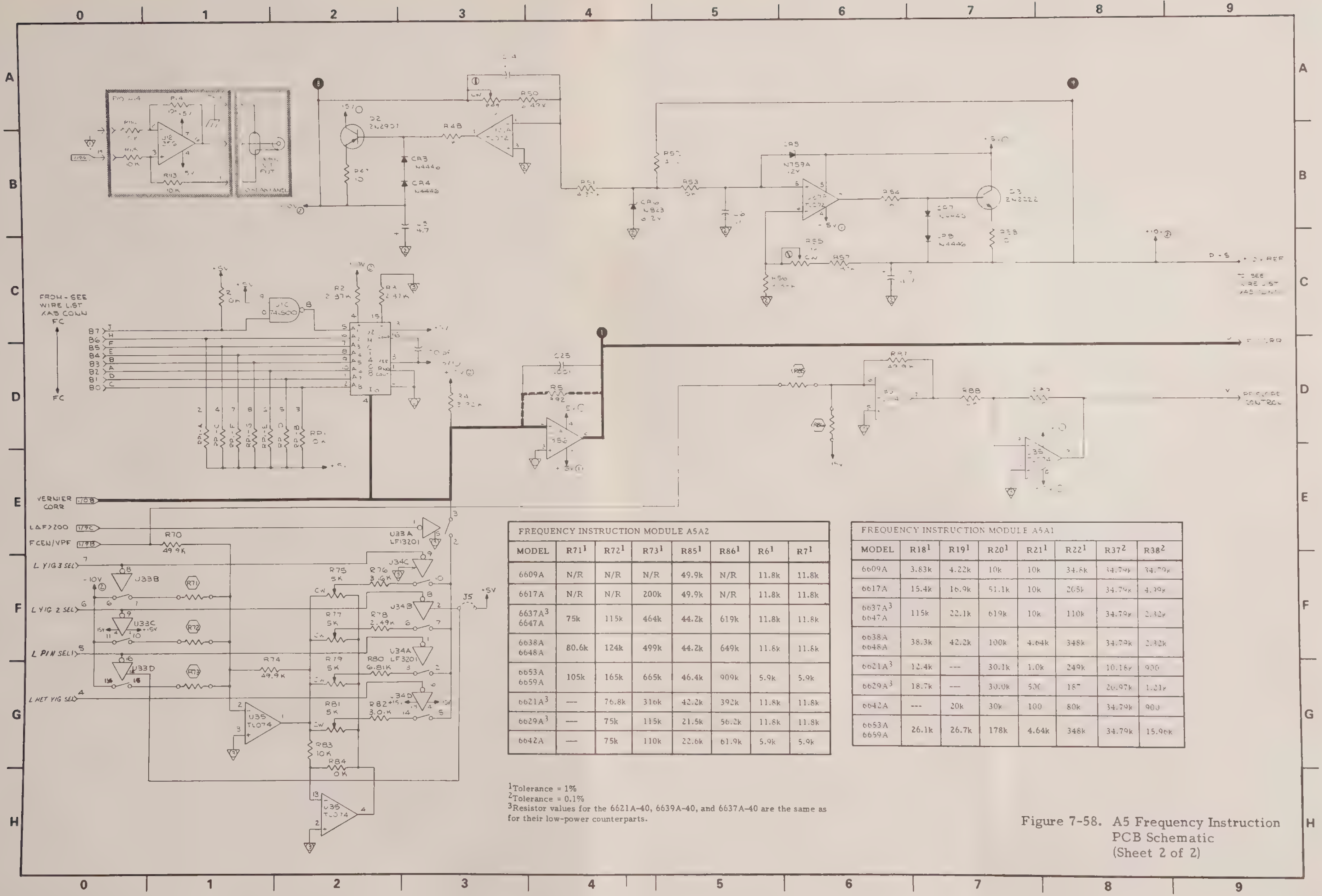

VERNIER CORR
OFFSET
FREQ OFFSET
U4 MC1408
DAC 73
U5 74LS374
U9 74LS374
74LS374
AD7541
U7 74LS374
U8 74LS374
AD7541
LM308
TL072
DG200
356
TO SEE WIRE LIST V45 CONN
F CEN SIG GND
F CEN
F CEN/VPF
LAF>200
V/GHZ
LCW MODE
CW FILTER
ΔF>50MHZ
ΔF<50MHZ REF
ΔF≤50MHZ
MAN SWP INPUT
RAMP INPUT
ANALOG GND
NOTES UNLESS OTHERWISE SPECIFIED
1. RESISTANCES ARE IN OHMS, CAPACITANCES IN MICROFARADS.
2. DENOTES SCREWDRIVER CONTROL.
3. DENOTES +5V RETURN.
4. DENOTES ANALOG GND 1, AND DENOTES RELATIVE VOLTAGES
5. DENOTES ANALOG GND2, AND -V DENOTES RELATIVE VOLTAGES
6. DENOTES ANALOG GND 3 AND -V DENOTES RELATIVE VOLTAGES
8. COMPONENTS ON SHEET
9. DENOTES PRIMARY SIGNAL PATH.
10. DENOTES FEEBACK SIGNAL PATH
NOT USED
CR10
TP10

Figure 7-58. A5 Frequency Instruction PCB Schematic (Sheet 1 of 2)


REV L
A B C D E F H J K L M N P R S T U V W X Y Z A B C D E F

A5 PCB Parts Locator Diagram

Figure 7-58 (Sheet 1 of 2)



U12
U33A LF13201
U33B
U33C
U33D
U34A LF3201
U34B
U34C
U34D
U35 TL074
Q2 2N2907
Q3 2N2222
CR3 1N4446
CR4 1N4446
CR5 1N759A 12V
R48
R50
R51
R53
R54
R55
R57
R58
R70 49.9K
R74 49.9K
R75 5K
R76 3.6K
R77 5K
R78 2.49K
R79 5K
R80 6.81K
R81 5K
R82 3.01K
R83 10K
R84 0K
R87
R88
C25 .001
J5
+5V
-10V
+15V
-15V
FROM - SEE WIRE LIST XA5 CONN FC
B7
B6
B5
B4
B3
B2
B1
B0
FC
VERNIER CORR
L ΔF>200
FCEN/VPF
L YIG 3 SEL
L YIG 2 SEL
L PIN SEL
L HET YIG SEL
+ 5V REF
TO SEE WIRE LIST XA5 CONN

FREQUENCY INSTRUCTION MODULE A5A2							
MODEL	R71[1]	R72[1]	R73[1]	R85[1]	R86[1]	R6[1]	R7[1]
6609A	N/R	N/R	N/R	49.9k	N/R	11.8k	11.8k
6617A	N/R	N/R	200k	49.9k	N/R	11.8k	11.8k
6637A[3] 6647A	75k	115k	464k	44.2k	619k	11.8k	11.8k
6638A 6648A	80.6k	124k	499k	44.2k	649k	11.6k	11.6k
6653A 6659A	105k	165k	665k	46.4k	909k	5.9k	5.9k
6621A[3]	—	76.8k	316k	42.2k	392k	11.8k	11.8k
6629A[3]	—	75k	115k	21.5k	56.2k	11.8k	11.8k
6642A	—	75k	110k	22.6k	61.9k	5.9k	5.9k

FREQUENCY INSTRUCTION MODULE A5A1							
MODEL	R18[1]	R19[1]	R20[1]	R21[1]	R22[1]	R37[2]	R38[2]
6609A	3.83k	4.22k	10k	10k	34.8k	34.79k	34.79k
6617A	15.4k	16.9k	51.1k	10k	205k	34.79k	4.99k
6637A[3] 6647A	115k	22.1k	619k	10k	110k	34.79k	2.32k
6638A 6648A	38.3k	42.2k	100k	4.64k	348k	34.79k	2.32k
6621A[3]	12.4k	---	30.1k	1.0k	249k	10.16k	900
6629A[3]	18.7k	---	30.0k	500	187	20.97k	1.21k
6642A	---	20k	30k	100	80k	34.79k	900
6653A 6659A	26.1k	26.7k	178k	4.64k	348k	34.79k	15.96k

[1] Tolerance = 1%

[2] Tolerance = 0.1%

[3] Resistor values for the 6621A-40, 6639A-40, and 6637A-40 are the same as for their low-power counterparts.

Figure 7-58. A5 Frequency Instruction PCB Schematic (Sheet 2 of 2)

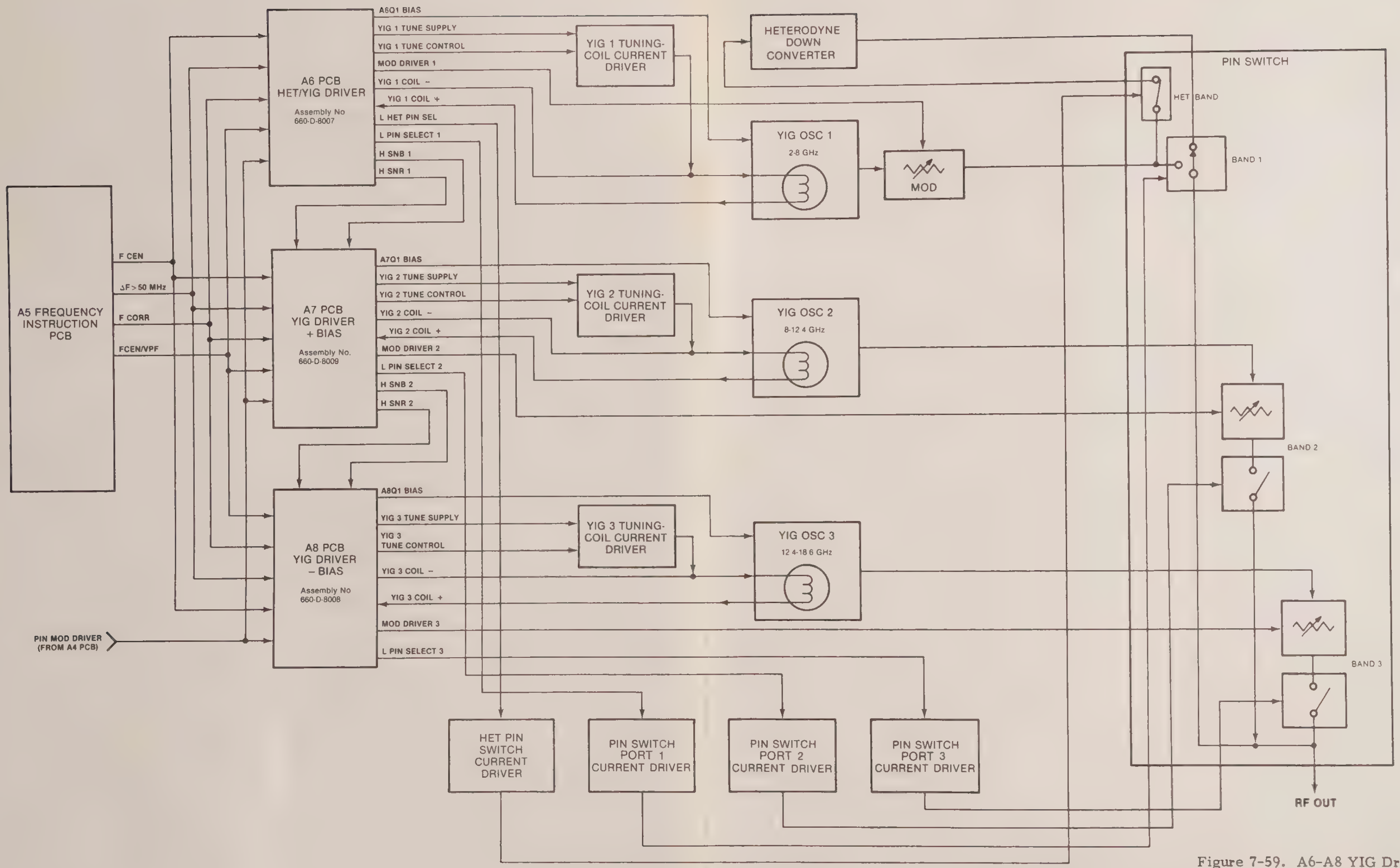

A5 FREQUENCY INSTRUCTION PCB
F CEN
ΔF > 50 MHz
F CORR
FCEN/VPF
PIN MOD DRIVER (FROM A4 PCB)
A6 PCB HET/YIG DRIVER
Assembly No 660-D-8007
A6Q1 BIAS
YIG 1 TUNE SUPPLY
YIG 1 TUNE CONTROL
MOD DRIVER 1
YIG 1 COIL −
YIG 1 COIL +
L HET PIN SEL
L PIN SELECT 1
H SNB 1
H SNR 1
A7 PCB YIG DRIVER + BIAS
Assembly No. 660-D-8009
A7Q1 BIAS
YIG 2 TUNE SUPPLY
YIG 2 TUNE CONTROL
YIG 2 COIL −
YIG 2 COIL +
MOD DRIVER 2
L PIN SELECT 2
H SNB 2
H SNR 2
A8 PCB YIG DRIVER − BIAS
Assembly No 660-D-8008
A8Q1 BIAS
YIG 3 TUNE SUPPLY
YIG 3 TUNE CONTROL
YIG 3 COIL −
YIG 3 COIL +
MOD DRIVER 3
L PIN SELECT 3
YIG 1 TUNING-COIL CURRENT DRIVER
YIG 2 TUNING-COIL CURRENT DRIVER
YIG 3 TUNING-COIL CURRENT DRIVER
HETERODYNE DOWN CONVERTER
YIG OSC 1
2-8 GHz
YIG OSC 2
8-12.4 GHz
YIG OSC 3
12.4-18.6 GHz
MOD
PIN SWITCH
HET BAND
BAND 1
BAND 2
BAND 3
RF OUT
HET PIN SWITCH CURRENT DRIVER
PIN SWITCH PORT 1 CURRENT DRIVER
PIN SWITCH PORT 2 CURRENT DRIVER
PIN SWITCH PORT 3 CURRENT DRIVER

Figure 7-59. A6-A8 YIG Driver PCBs Overall Block Diagram

7-12.2 A6–A9 YIG Driver PCBs, Overall Description

The A6-A9 YIG Driver PCBs provide (1) drive currents for both the PIN switch and the bands 1 thru 4 YIG oscillator tuning coils and (2) modulating currents for the ALC-loop PIN attenuator (paragraph 7-11.1). The PCBs also develop the oscillator-bandswitch logic voltages.

Some 6600A models, such as the 6653A and 6659A, use four YIG oscillators to sweep their frequency range. Each YIG oscillator requires a YIG Driver PCB; consequently, the 6600A sweep generators have four YIG Driver PCB slots: A6-A9. For 6600A models having less than four YIG oscillators, the unused slots contain jumper plugs. To provide for YIG oscillators that have been designed and built by different manufacturers, there are five different YIG Driver PCB designs. Each of these designs is identified by a unique assembly (Assy) number. To further provide for the models different frequency ranges each assembly number contains a dash-number breakout. Table 7-17 tabulates these assembly numbers and relates them to circuit-card slots and model numbers. This table also gives the paragraph number in which the Assy is described.

An example describing how the YIG Driver PCBs interface for multi-YIG models is provided below. This narrative, in conjunction with Figure 7-59 (facing page), describes the A6-A8 YIG Driver PCB operation for the 6647A or 6648A. For this discussion, assume the sweep is starting at 10 MHz.

The three main signals that cause a tuning and bias current to be developed are the **F CEN**, **ΔF>50 MHz**, and **F CORR** signals from the A5 PCB (paragraph 7-12.1). These three signals are applied in parallel to all three YIG driver PCBs. However, because the **H SNB** (select next band) 1 and 2 oscillator-bandswitch lines are both FALSE, the A6 is the only PCB that can use the signals. Here they are summed and used to generate the frequency sweep.

The fourth A5 signal, **FCEN/VPF**, provides for oscillator bandswitching. An A6 bandswitch occurs when 2 GHz is reached and again when 8 GHz is reached. At 2 GHz , **L HET PIN SELECT** goes FALSE and switches the Het Band out and Band 1 to YIG Osc 1. At 8 GHz, several events occur:

- The YIG oscillator tuning coil retunes the oscillator to a rest frequency of 2 GHz.
- The **MOD DRIVER 1** line sets the Mod attenuator to maximum attenuation, and the **L PIN SELECT 1** line causes the PIN Switch's Osc 1 switch to be turned off. This action attenuates by ≥60 dBc the feedthrough of the oscillator 1 signal.
- The **SNB 1** and **SNR 1** oscillator-bandswitch and select-next-ROM lines toggle from LOW to HIGH, causing the Osc 2 YIG and linearizer ROM to be selected.

When Osc 2 is selected, the A7 PCB sums the three signals from A5 (**F CEN, ΔF>50 MHz, F CORR**) and uses them to generate the Osc 2 sweep, starting at 8 GHz. As on A6, the **FCEN/VPF** signal from A5 provides for oscillator bandswitching. The A7 has only one bandswitch point (12.4 GHz) and when it is reached, the following occur:

- The YIG oscillator tuning coil retunes the oscillator to a rest frequency of 8 GHz.
- The **MOD DRIVER 2** line sets the PIN Switch's Osc 2 attenuator to maximum attenuation, and the **L PIN SELECT 2** line turns the Osc 2 switch off. This action attenuates by ≥60 dBc the feedthrough of the oscillator 2 signal.
- The **SNB 2** and **SNR 2** lines toggle from LOW to HIGH and select the Osc 3 YIG and ROM.

The Osc 3 circuit action is similar to that described for Osc 1 and Osc 2. The Osc 3 YIG rest frequency is 12.4 GHz.

Table 7-17. YIG Driver PCB Loading

YIG DRIVER ASSY NO.	PCB SLOT	YIG OSCILLATOR PART NO.	MODEL(S)	CIRCUIT DESCRIPTION PARAGRAPH NO.	SCHEMATIC FIG. NO.
660-D-8007-3	A6	1005-47	6637A, 6647A	7-12.3	7-62
660-D-8007-4	A6	1005-45	6609A	7-12.4	7-67
660-D-8007-5	A6	1005-47	6638A, 6648A	7-12.3	7-62
660-D-8007-6	A6	1005-47	6617A	7-12.5	7-70
660-D-8007-7	A6	1005-47	6653A, 6659A	7-12.3	7-63
660-D-8007-99-91	A6	1005-47	6621A	7-12.3	7-62
660-D-8190-99-96	A6	1005-35	6642A	7-12.6	7-73
660-D-12868-3	A6	1005-47	6637A-40	7-12.3	7-64
660-D-12868-99-91	A6	1005-47	6621A-40	7-12.3	7-64
660-D-8009-4	A7	1005-53	6637A, 6647A	7-12.7	7-78
660-D-8009-6	A7	1005-53	6638A, 6648A	7-12.7	7-78
660-D-8009-7	A7	1005-54	6637A, 6647A	7-12.7	7-78
660-D-8009-8	A7	1005-54	6638A, 6648A	7-12.7	7-78
660-D-8009-9	A7	1005-53	6653A, 6659A	7-12.7	7-79
660-D-8009-12	A7	1005-54	6653A, 6659A	7-12.7	7-79
660-D-8009-14	A7	1005-53	6637A-40	7-12.7	7-82
660-D-8009-17	A7	1005-53	6637A-40	7-12.7	7-82
660-D-8009-99-92	A7	1005-53	6629A-40	7-12.7	7-82
660-D-8009-99-90	A7	1005-53	6621A-40	7-12.7	7-82
660-D-8191-99-93	A7	1005-40	6642A	7-12.6	7-74
660-D-8009-99-90	A7	1005-53	6621A	7-12.7	7-78
660-D-8009-99-91	A7	1005-53	6629A	7-12.7	7-78
660-D-8008-4	A8	1005-51	6637A, 6647A	7-12.7	7-76
660-D-8008-7	A8	1005-52	6638A, 6648A	7-12.7	7-76
660-D-8008-99-90	A8	1005-55	6629A-40	7-12.7	7-76
660-D-8009-10	A8	1005-51	6653A, 6659A	7-12.7	7-80
660-D-8009-13	A8	1005-59	6653A, 6659A	7-12.7	7-80
660-D-8009-15	A8	1005-55	6637A-40	7-12.7	7-83
660-D-8009-16	A8	1005-59	6637A-40	7-12.7	7-83
660-D-8009-11	A9	1005-61	6653A, 6659A	7-12.7	7-81

7-12.3 Assy 660-D-8007-3, -5, -7, and -99-91; -12868-3 and -99-91 Het/YIG Driver PCBs, Circuit Description

The Het/YIG Driver PCB generates the following voltages and currents:

- A tuning current for the Osc 1 YIG.
- A modulating current for the Osc 1 attenuator (Assy. 660-B-9432), which is located in the Osc 1 YIG output circuit.
- A tracking filter voltage for the Osc 1 YIG. (This filter is mounted inside the Osc 1 YIG package and provides ≥40 dB of harmonic suppression.)
- A fixed bias voltage (-5V) for the Osc 1 YIG.
- Linearizer ROM output data. (A linearizing ROM, if installed, provides correction data for making the frequency characteristics of the YIG oscillator linear.)
- Bandswitch logic voltages.

A block diagram for the Het/YIG PCB is shown in Figure 7-60. A simplified schematic of the E/I (voltage to current) Converter circuit is given in Figure 7-61. The -8007-3, -5, and -99-91 PCB schematic is shown in Figure 7-62. The -8007-7 PCB schematic is shown in Figure 7-63. And the -12868-3, -99-91 schematic is shown in Figure 7-64.

The **F CEN**, **ΔF>50 MHz**, and **F CORR** signals generated on the A5 PCB are summed together at the E/I Converter (Figure 7-61) and used to generate the YIG tuning-coil current. The E/I Converter circuit consists of all the components shown in Figure 7-61. As shown, the three A5 voltage signals are applied to U4, via U3D. If the output frequency is <2 GHz, a heterodyne offset voltage via U3B is also summed in with the A5 voltages. This offset voltage causes the YIG to sweep between 4.61 and 6.6 GHz. When this 4.61 to 6.6 GHz sweep is beat with the output from the 4.6 GHz local oscillator in the Down Converter, a 10 MHz to 2 GHz sweep results.

The output from U4 controls the current through the YIG tuning coil, via transistor A6Q2 (located on the RF Deck). The current through the coil develops a proportional voltage drop across sense resistor (R SENSE) R15.

When the output frequency goes above 2 GHz, a bandswitch occurs. The Bandswitch/ROM Select Logic (Figure 7-60) causes the **L HET YIG SEL** line to go FALSE and open U3B. When U3B opens, the heterodyne offset voltage is removed from the U4 input. The U4 output then causes the YIG to sweep between 2 and 8 GHz.

When the output frequency goes above 8 GHz, the Bandswitch/ROM Select Logic causes the **L YIG SEL** line to go FALSE. When this line goes FALSE, U3D opens and U3A closes. When U3A closes, the R_{fb} (rest) resistor R17 provides the input to U4. This R17 input to U4 causes the YIG coil to tune the oscillator to a rest frequency of 2 GHz. Also, when the **L YIG SEL** line goes FALSE, it causes transistor Q1 to saturate and reverse-bias transistor A6Q3. When A6Q3 is reverse-biased, -15 volts is applied to the emitter of A6Q2. This reduced emitter voltage causes less current to flow through A6Q2 and less heat to be developed across the transistor.

The remaining input to the E/I Converter is the **CW FILTER** line. When the microprocessor commands that the CW filter be inserted, relay K1 is activated. (The CW filter is inserted when the sweep width is ≤50 MHz or when a CW mode has been selected from the front panel.) When K1 is activated, the R27-C16 network creates an alternate path around the YIG oscillator. This path reduces the noise current flowing through the coil, thereby quieting the YIG oscillator frequency output.

As shown in Figure 7-60, the input to the Tracking Filter Voltage Generator (U2A-U2D) is the voltage ramp developed across R Sense (R15). This R15 voltage ramp is modified in slope (gain) and offset (if necessary) and used indirectly to tune the Band 1 YIG tracking filter. If the Band 1 YIG is supplying the output frequency, the L **YIG SEL** line will be TRUE, closing U3C. When U3C closes, it supplies the **TRACK FILTER 1** signal to the A10 PCB, which develops a tuning current for the tracking filter coil.

The inputs to the Bandswitch/ROM Select Logic circuit (U1A, U1B, U1C, U10B, U10C) are the **FCEN/VPF** and **F CEN** voltage signals from the A5 PCB. The **FCEN/VPF** voltage is compared at U9A with a voltage representing 8 GHz and at U9B with a voltage representing 2 GHz. When the **FCEN/VPF** voltage equals or exceeds the 2 GHz voltage at U9B, the L **HET YIG SEL**, L **HET PIN SEL**, and L **HET OFFSET** lines go FALSE. When the **FCEN/VPF** voltage equals or exceeds the 8 GHz voltage at U9A, the L **YIG SEL**, L **YIG 1 SEL**, and L **PIN SELECT** 1 lines go FALSE and the **H SNB 1** line goes TRUE. When the **F CEN** voltage equals or exceeds the 8 GHz voltage at U9C, the **H SNR 1** line goes TRUE (**L ROM SEL** line goes FALSE).

In addition to the **FCEN/VPF** and **F CEN** analog voltage inputs, there are two logic control inputs to the Bandswitch/ROM Select Logic. These logic control inputs are **L RF OFF** and L **PIN SW OFF**. The L **RF OFF** input is from the microprocessor, via a latch on the A4 PCB. The L **PIN SW OFF** input is from the Sq Wave Sample/Hold Logic circuit on the A4 PCB (paragraph 7-11.1g). When either of these two logic inputs goes TRUE, both the L **HET PIN** SELECT and L **PIN** SELECT 1 lines go FALSE.

When the L **HET PIN** SELECT lines is FALSE, it reverse-biases A14CR17 (Figure 7-62, Sheet 3). Reverse-biasing CR17 causes A14Q5 to turn on, A14Q8 to turn on, and A14Q9 to turn off. When on, Q8 sources current into the PIN Switch. This current shunts the RF at J1 to ground and places a high attenuation between J1 and J5 – the RF OUT port.

Conversely, when the L **HET PIN SELECT** line is TRUE (.01-2 GHz Het Band is selected), CR17 is forward-biased. Forward-biasing CR17 causes Q5 to turn off, Q8 to turn off, and Q9 to turn on. When on, Q9 sinks current from the PIN Switch. This current biases the switch so that RF is passed from J1 to J5.

When the L **PIN SELECT** 1 line changes states, the circuit composed of A14CR18, A14Q6, Q14Q10, and A14Q11 is used to operate the Osc 1 section of the PIN Switch. The operation of this circuit is identical to that described above for the CR17-Q5-Q8-Q9 circuit.

The inputs to the Linearizing ROM (U5) are the **ROM Bus** lines from the microprocessor, via the A14U6 latch on the motherboard. The Linearizing ROM is enabled by the TRUE state of the L **ROM SEL** line from the Bandswitch Logic circuit. When enabled this ROM outputs eight bits of data to the A5 PCB.

The input to the PIN Driver/Linearizer (ALC) circuit (U7A, U8B, Q6, Q7) is from the A4 PCB. This circuit has two functions: (1) It provides the Band 1 ALC-loop-gain adjustment, and (2) it makes linear the relationship between the A4 PCB Level Amp output in Vdc (paragraph 7-11.1) and the RF power output in dBm. Control for the PIN Driver/Linearizer circuit is provided by the **H YIG SEL** line from the E/I Converter circuit. The **H YIG SEL** line is TRUE when the Band 1 YIG is supplying the output frequency. The output from this circuit is a current, **MOD DRIVER 1**. This current is supplied to the MOD (Modulator) component on the RF Deck, via A14R34 (Figure 7-62, Sheet 3).

The input to the -5V Bias Supply (U7B, U8A, Q3, Q4, Q5) is the control line, **L RF OFF**. When the front panel RF ON switch is disengaged (out), the microprocessor sets this line TRUE. When **L RF OFF** is TRUE, the -5V Bias Supply is turned off; thus turning off the Band 1 YIG oscillator.

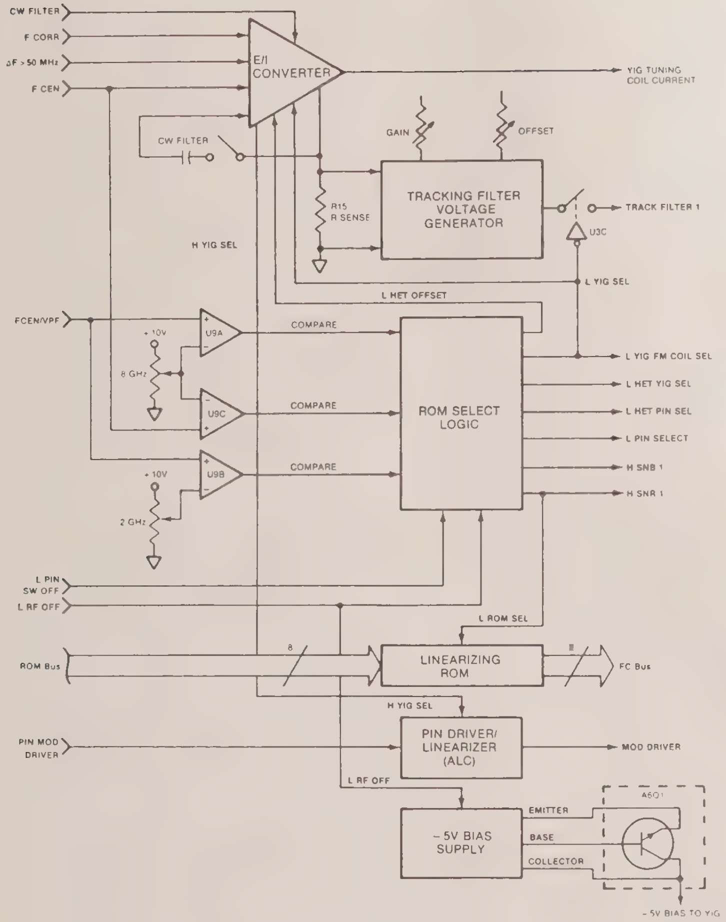

CW FILTER
F CORR
ΔF > 50 MHz
F CEN
E/I CONVERTER
YIG TUNING COIL CURRENT
CW FILTER
GAIN
OFFSET
R15 R SENSE
TRACKING FILTER VOLTAGE GENERATOR
TRACK FILTER 1
U3C
H YIG SEL
L YIG SEL
L HET OFFSET
FCEN/VPF
+10V
8 GHz
U9A
U9C
COMPARE
COMPARE
COMPARE
+10V
2 GHz
U9B
ROM SELECT LOGIC
L YIG FM COIL SEL
L HET YIG SEL
L HET PIN SEL
L PIN SELECT
H SNB 1
H SNR 1
L PIN SW OFF
L RF OFF
L ROM SEL
ROM Bus
8
LINEARIZING ROM
8
FC Bus
H YIG SEL
PIN MOD DRIVER
PIN DRIVER/ LINEARIZER (ALC)
MOD DRIVER
L RF OFF
−5V BIAS SUPPLY
EMITTER
BASE
COLLECTOR
A6Q1
−5V BIAS TO YIG

Figure 7-60. A6 Het/YIG Driver PCB (Assy. 660-D-8007 (Block Diagram)

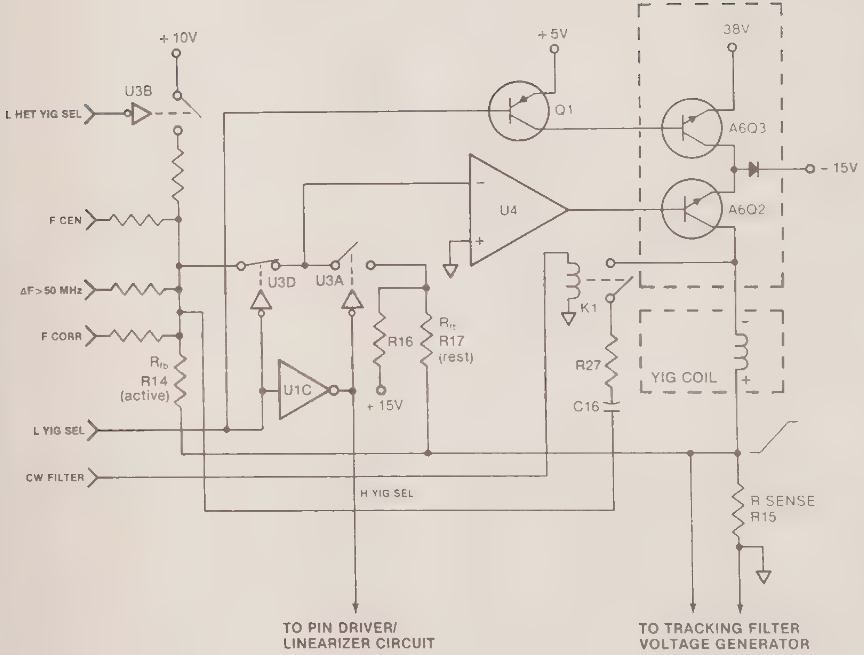
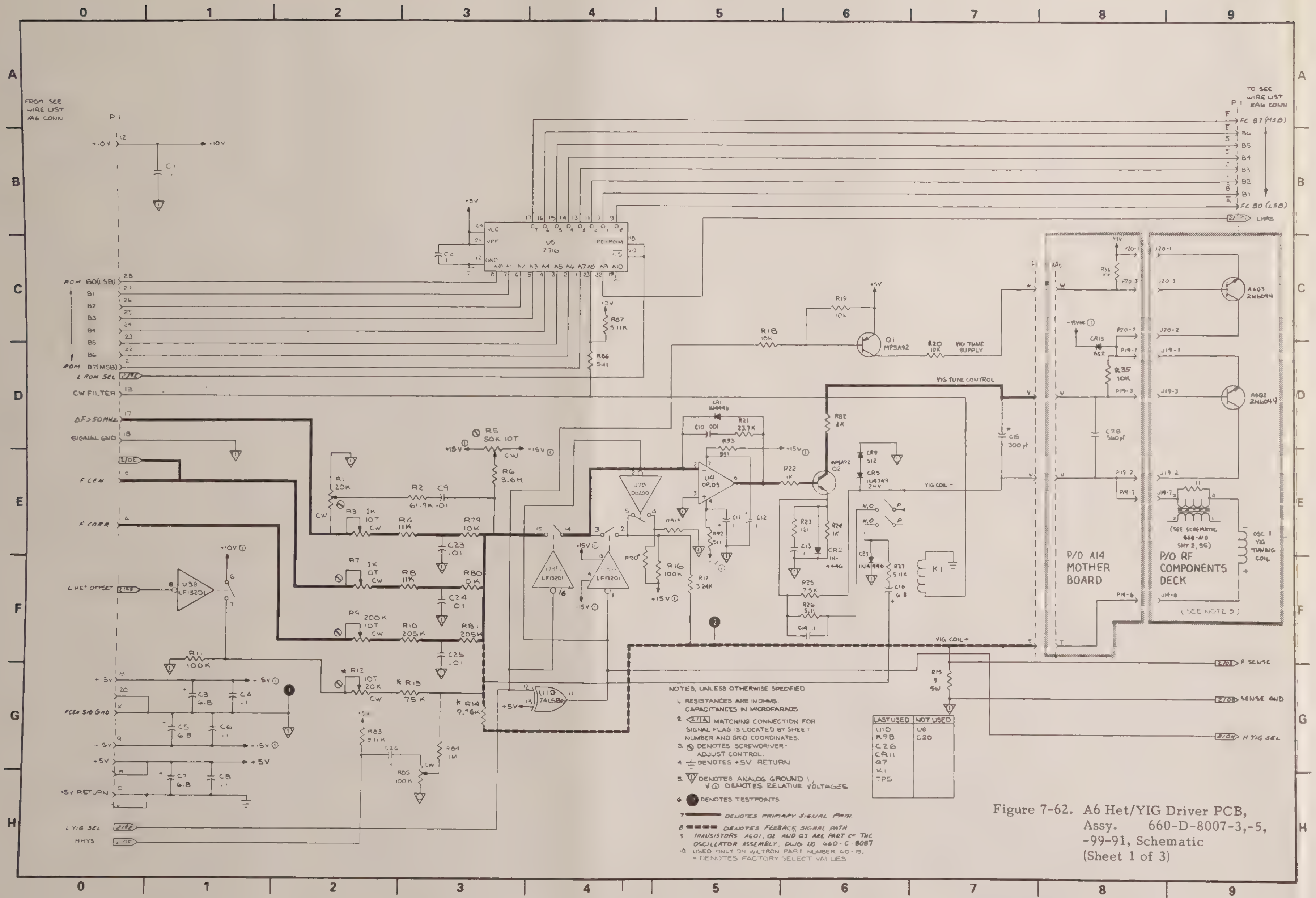

+10V
U3B
L HET YIG SEL
+5V
Q1
38V
A6Q3
−15V
A6Q2
U4
F CEN
ΔF>50 MHz
F CORR
U3D
U3A
R16
R17 (rest)
R_{ri}
R_{fb}
R14 (active)
U1C
+15V
K1
R27
C16
YIG COIL
L YIG SEL
CW FILTER
H YIG SEL
R SENSE R15
TO PIN DRIVER/ LINEARIZER CIRCUIT
TO TRACKING FILTER VOLTAGE GENERATOR

Figure 7-61. A6 Het/YIG Driver PCB E/I Converter Circuit Simplified Schematic


P1
+10V
C1
ROM B0 (LSB)
B1
B2
B3
B4
B5
B6
ROM B7 (MSB)
L ROM SEL
CW FILTER
ΔF≥50MHz
SIGNAL GND
F CEN
F CORR
L HET OFFSET
U3B LF13201
+5V
FCEN SIG GND
-5V
+5V RETURN
L YIG SEL
HHYS
U5 2716
R5 50K 10T
R6 3.6M
U4 OP-05
U7C DG200
Q1 MPSA92
Q2 MPSA42
R18
R19 10K
R20 10K
YIG TUNE SUPPLY
YIG TUNE CONTROL
YIG COIL -
YIG COIL +
U1D 74LS86
R15 5 5W
P/O A14 MOTHER BOARD
P/O RF COMPONENTS DECK
A603 2N6044
A602 2N6044
OSC 1 YIG TUNING COIL
(SEE NOTE 9)
R SENSE
SENSE GND
H YIG SEL
FC B7 (MSB)
FC B0 (LSB)
TO SEE WIRE LIST XA6 CONN
FROM SEE WIRE LIST XA6 CONN

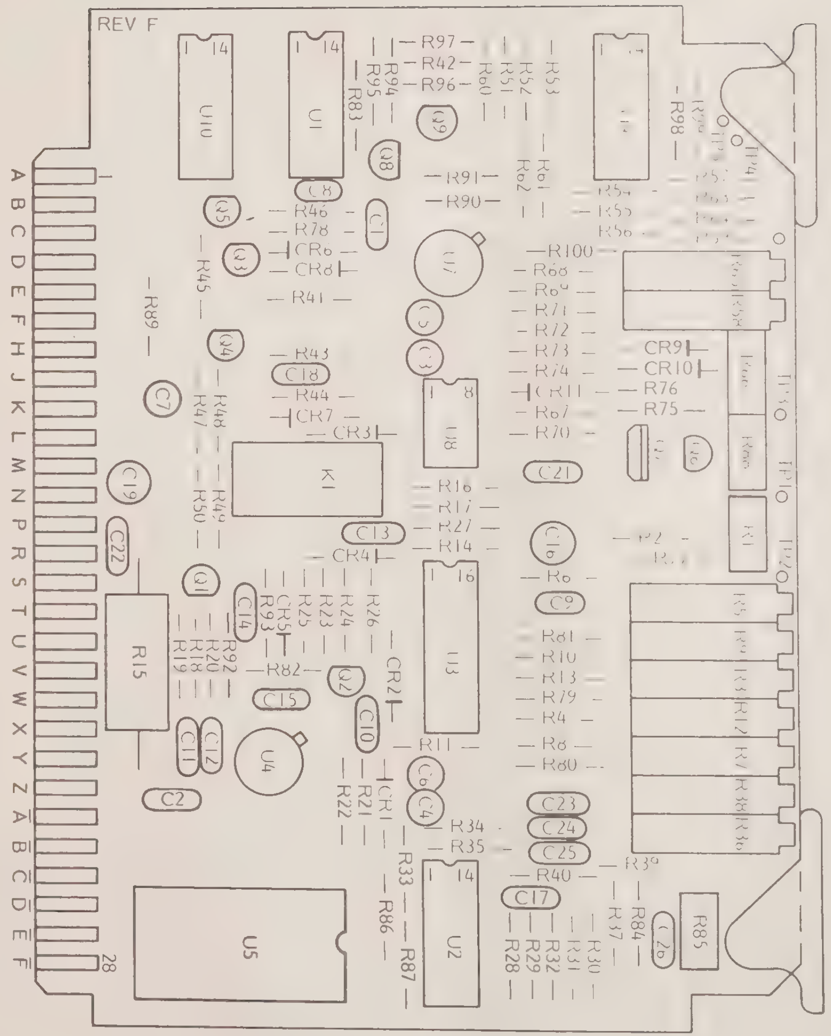
NOTES, UNLESS OTHERWISE SPECIFIED

1. RESISTANCES ARE IN OHMS. CAPACITANCES IN MICROFARADS
2. 2/1A MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.
3. ⊘ DENOTES SCREWDRIVER-ADJUST CONTROL.
4. ⏚ DENOTES +5V RETURN
5. ▽ DENOTES ANALOG GROUND 1, V① DENOTES RELATIVE VOLTAGES
6. ● DENOTES TESTPOINTS
7. ▬ DENOTES PRIMARY SIGNAL PATH.
8. ▬ ▬ DENOTES FEEBACK SIGNAL PATH
9. TRANSISTORS A601, 02 AND Q3 ARE PART OF THE OSCILLATOR ASSEMBLY. DWG NO 660-C-8087
10. USED ONLY ON WILTRON PART NUMBER 60-15.

* DENOTES FACTORY SELECT VALUES

LAST USED	NOT USED
U10	U6
R98	C20
C26	
CR11	
Q7	
K1	
TP5	

Figure 7-62. A6 Het/YIG Driver PCB, Assy. 660-D-8007-3,-5, -99-91, Schematic (Sheet 1 of 3)


REV F
U10
U1
U5
U2
U3
U4
U7
U8
K1
R15
R85
Q1
Q2
Q3
Q4
Q5
Q8
Q9
A
B
C
D
E
F
H
J
K
L
M
N
P
R
S
T
U
V
W
X
Y
Z
28

A6 PCB Parts Locator Diagram

Figure 7-62 (Sheet 1 of 3)

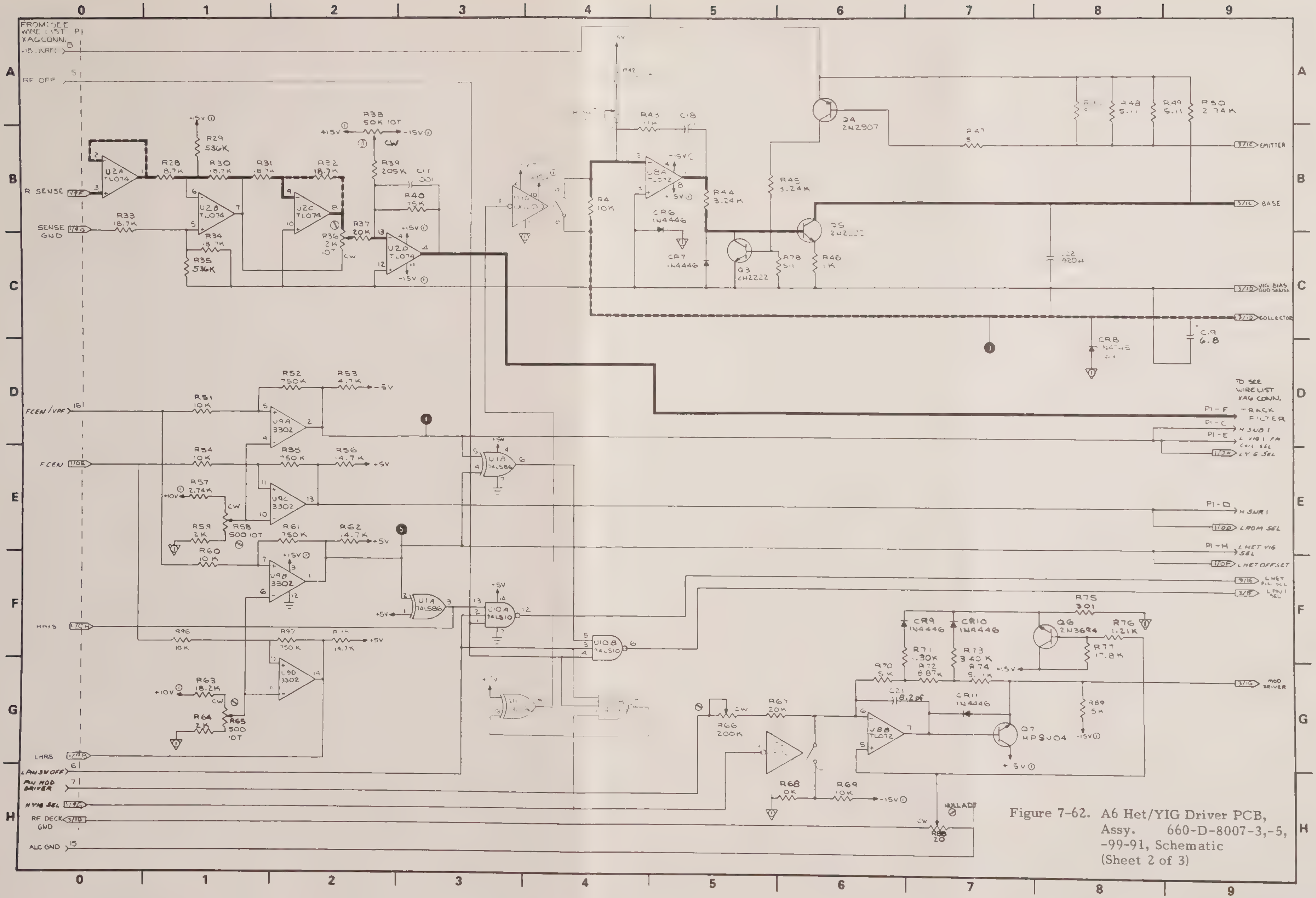

FROM: SEE WIRE LIST P1 XA6 CONN.
+18 UNREG
RF OFF
R SENSE
SENSE GND
U2A TL074
U2B TL074
U2C TL074
U2D TL074
R28 8.7K
R29 536K
R30 18.7K
R31 18.7K
R32 18.7K
R33 18.7K
R34 18.7K
R35 536K
R36 2K 10T
R37 20K
R38 50K 10T
R39 205K
R40 75K
C17 .001
CW
+15V
-15V
U8A TL072
R4 10K
R43
C18
R44 3.24K
R45 3.24K
R46 1K
R47 5
R48 5.11
R49 5.11
R50 2.74K
R78 5.11
CR6 1N4446
CR7 1N4446
Q3 2N2222
Q4 2N2907
Q5
C22 820pf
CR8
C19 6.8
3/1C EMITTER
3/1C BASE
3/1D YIG BIAS GND SENSE
3/1D COLLECTOR
TO SEE WIRE LIST XA6 CONN.
P1-F TRACK FILTER
P1-C H SNB1
P1-E L YIG1 FM COIL SEL
1/5H L YG SEL
P1-D H SNR1
1/6D L ROM SEL
P1-H L HET YIG SEL
1/6F L HET OFFSET
3/1E L HET PIN SEL
3/1F L PIN 1 SEL
FCEN/VPF
FCEN
HHYS
LHRS
L PIN SW OFF
PIN MOD DRIVER
H YIG SEL
RF DECK GND
ALC GND
U9A 3302
U9B 3302
U9C 3302
U9D 3302
R51 10K
R52 750K
R53 4.7K
R54 10K
R55 750K
R56 4.7K
R57 2.74K
R58 500 10T
R59 2K
R60 10K
R61 750K
R62 4.7K
R63 18.2K
R64 2K
R65 500 10T
R96 10K
R97 750K
14.7K
+10V
+5V
-5V
U1B 74LS86
U1A 74LS86
U10A 74LS10
U10B 74LS10
CR9 1N4446
CR10 1N4446
CR11 1N4446
R66 200K
R67 20K
R68 10K
R69 10K
R70 5K
R71 1.30K
R72 887K
R73 340K
R74 5.1K
R75 301
R76 1.21K
R77 17.8K
R89 5K
C21 8.2pf
Q6 2N3694
Q7 HPSU04
U8B TL072
R88 20
NULL ADJ
3/1G MOD DRIVER
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

Figure 7-62. A6 Het/YIG Driver PCB, Assy. 660-D-8007-3,-5, -99-91, Schematic (Sheet 2 of 3)

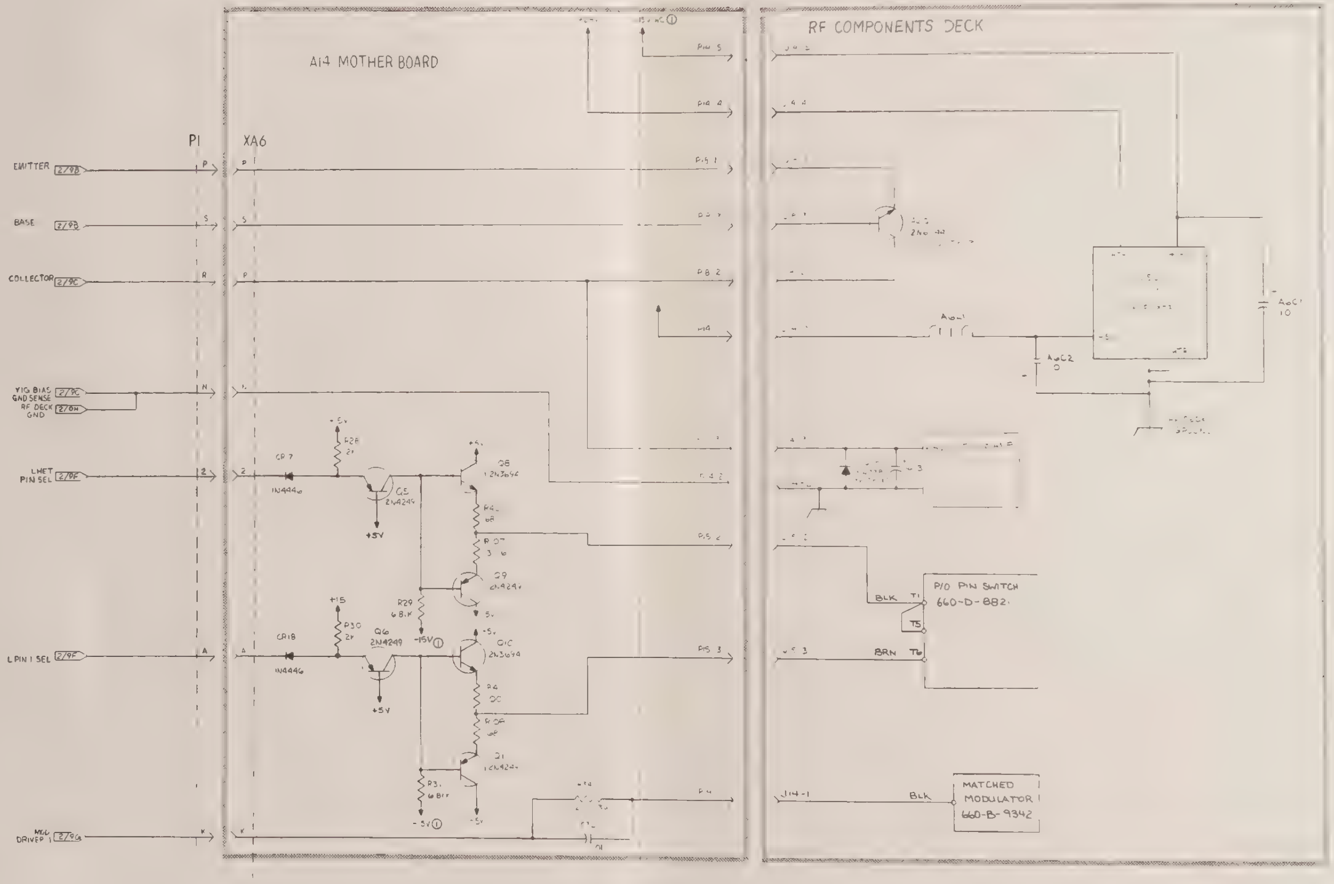
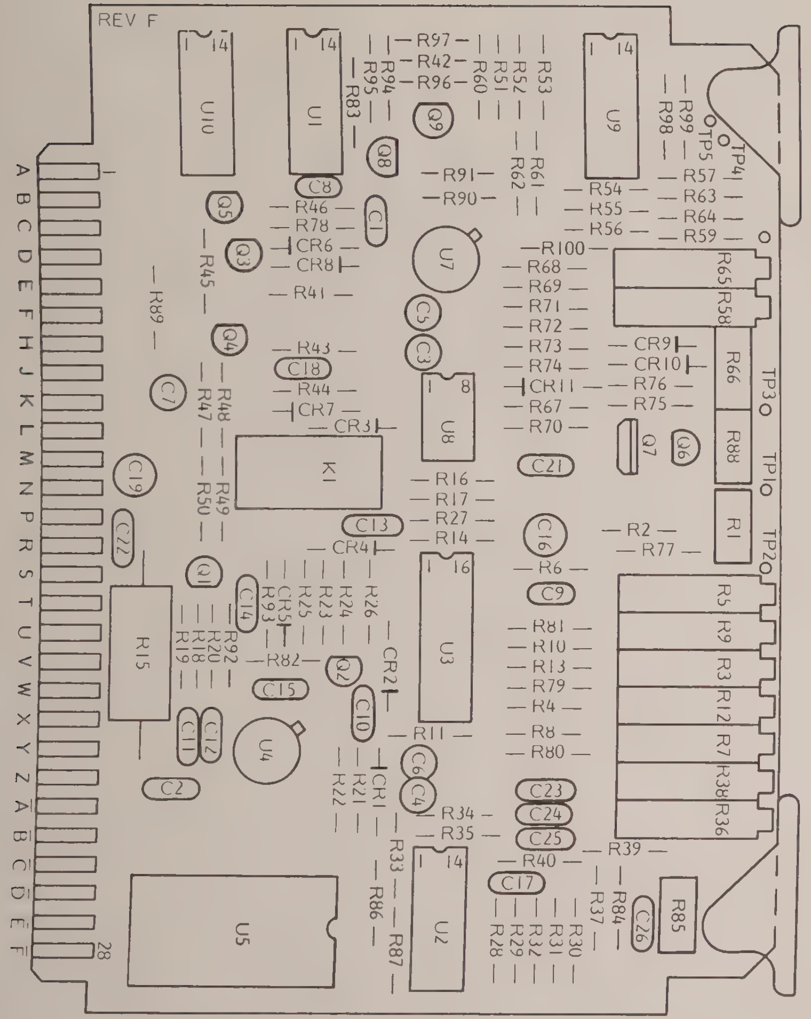
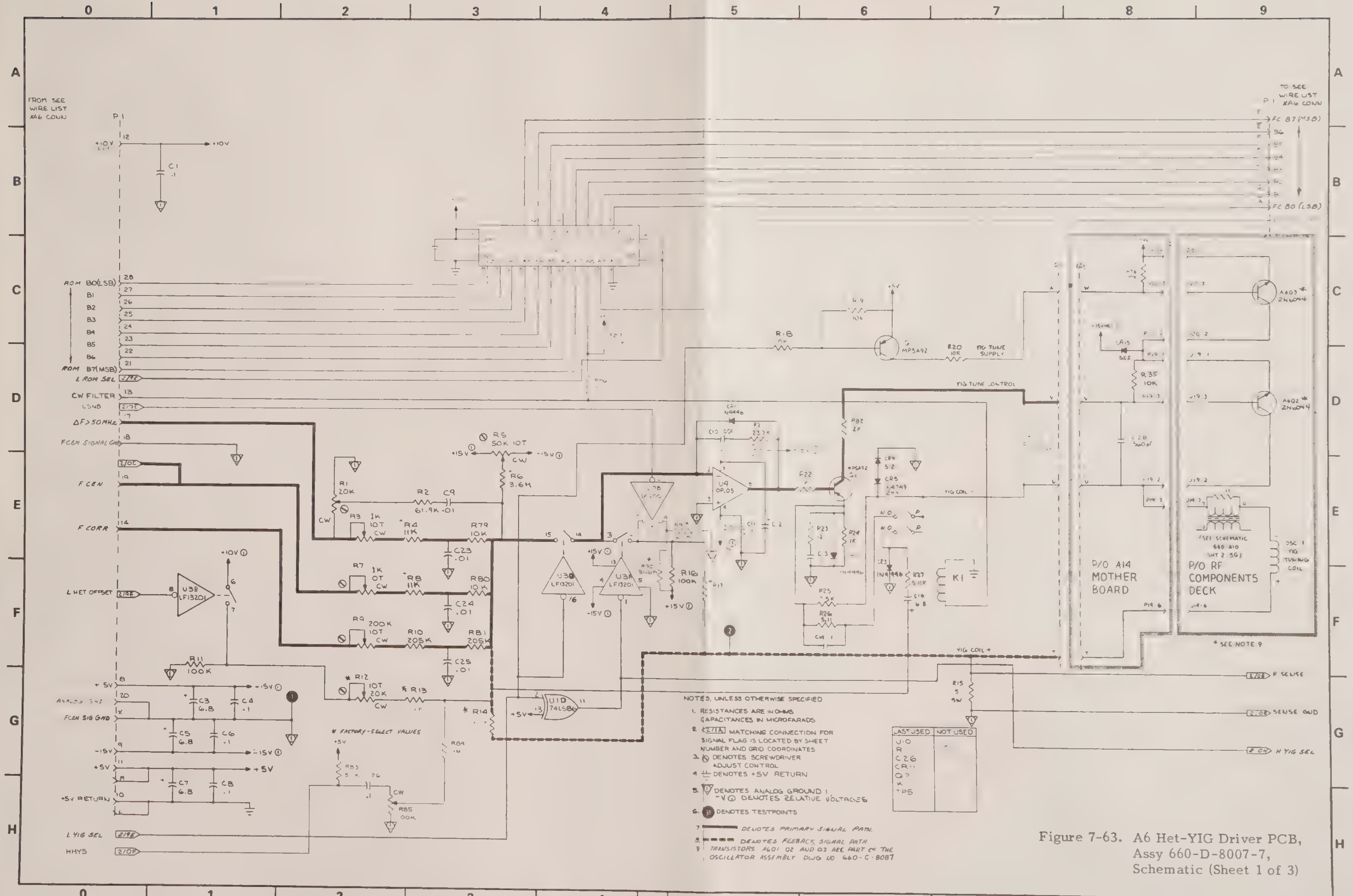

A14 MOTHER BOARD
RF COMPONENTS DECK
P1
XA6
EMITTER 2/9B
BASE 2/9B
COLLECTOR 2/9C
YIG BIAS GND SENSE 2/9C
RF DECK GND 2/0H
LHET PIN SEL 2/9F
L PIN 1 SEL 2/9F
MOD DRIVER 1 2/9G
P
S
R
N
2
A
K
+5V
R28 2K
CR7
1N4446
Q5 2N4249
+5V
Q8 2N3694
R4 68
R27 3.6
Q9 2N4249
R29 6.8K
-15V ①
+15
R30 2K
CR18
1N4446
Q6 2N4249
+5V
Q10 2N3694
R4 20
R26 68
Q11 2N4249
R31 6.8K
-5V ①
-5V
PIN 5
PIN 4
PIN 1
PIN 2
PIN 3
A6C1 10
A6C2
J14-1
BLK
P/O PIN SWITCH
660-D-882
T1
T5
T6
BRN
MATCHED
MODULATOR
660-B-9342

Figure 7-62. A6 Het/YIG Driver PCB, Assy. 660-D-8007-3,-5, -99-91, Schematic (Sheet 3 of 3)


REV F
U10
U1
U9
U7
U8
K1
U3
U4
U2
U5
R15
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
TP1
TP2
TP3
TP4
TP5
TP10
R97
R42
R96
R91
R90
R100
CR9
CR10
CR11
CR3
CR4
CR6
CR7
CR1
CR2
A B C D E F H J K L M N P R S T U V W X Y Z Ā B̄ C̄ D̄ Ē F̄
28

A6 PCB Parts Locator Diagram


FROM SEE WIRE LIST XA6 CONN
P1
+10V
C1 .1
ROM B0(LSB)
B1
B2
B3
B4
B5
B6
ROM B7(MSB)
L ROM SEL
CW FILTER
LSNB
ΔF>50MHz
FCEN SIGNAL GND
F CEN
F CORR
L HET OFFSET
U3B LF13201
R11 100K
+5V
ANALOG GND
FCEN SIG GND
-15V
+5V RETURN
L YIG SEL
HHYS
C3 6.8
C4 .1
C5 6.8
C6 .1
C7 6.8
C8 .1
R1 20K
R2 61.9K
C9 .01
R3 1K 10T
R4 11K
R5 50K 10T
R6 3.6M
R7 1K 10T
R8 11K
R9 200K 10T
R10 205K
R12 10T 20K
R13
R14
R16 100K
R79 10K
R80 10K
R81 205K
C23 .01
C24 .01
C25 .01
U3D LF13201
U3A LF13201
U1D 74LS86
U4 OP-05
* FACTORY-SELECT VALUES
MPSA92
R20 10K
YIG TUNE SUPPLY
YIG TUNE CONTROL
YIG COIL -
YIG COIL +
R15 5 5W
K1
1N4446
TO SEE WIRE LIST XA6 CONN
FC B7(MSB)
FC B0(LSB)
A6Q3* 2N6044
A6Q2* 2N6044
R35 10K
C28 560pF
P/O A14 MOTHER BOARD
P/O RF COMPONENTS DECK
(SEE SCHEMATIC 660-A10 SHT 2 5G)
OSC 1 YIG TUNING COIL
* SEE NOTE 9
R SENSE
SENSE GND
H YIG SEL
A B C D E F G H
0 1 2 3 4 5 6 7 8 9

NOTES, UNLESS OTHERWISE SPECIFIED

1. RESISTANCES ARE IN OHMS CAPACITANCES IN MICROFARADS
2. 2/1A MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES
3. ⊘ DENOTES SCREWDRIVER ADJUST CONTROL
4. ⏚ DENOTES +5V RETURN
5. ▽① DENOTES ANALOG GROUND 1 -V① DENOTES RELATIVE VOLTAGES
6. ㉛ DENOTES TESTPOINTS
7. ━━━ DENOTES PRIMARY SIGNAL PATH.
8. ╍╍╍ DENOTES FEEBACK SIGNAL PATH
9. TRANSISTORS A601 Q2 AND Q3 ARE PART OF THE OSCILLATOR ASSEMBLY DWG NO 660-C-8087

LAST USED	NOT USED
U10 R C26 CR11 Q9 K TP5	-

Figure 7-63. A6 Het-YIG Driver PCB, Assy 660-D-8007-7, Schematic (Sheet 1 of 3)

parts locator

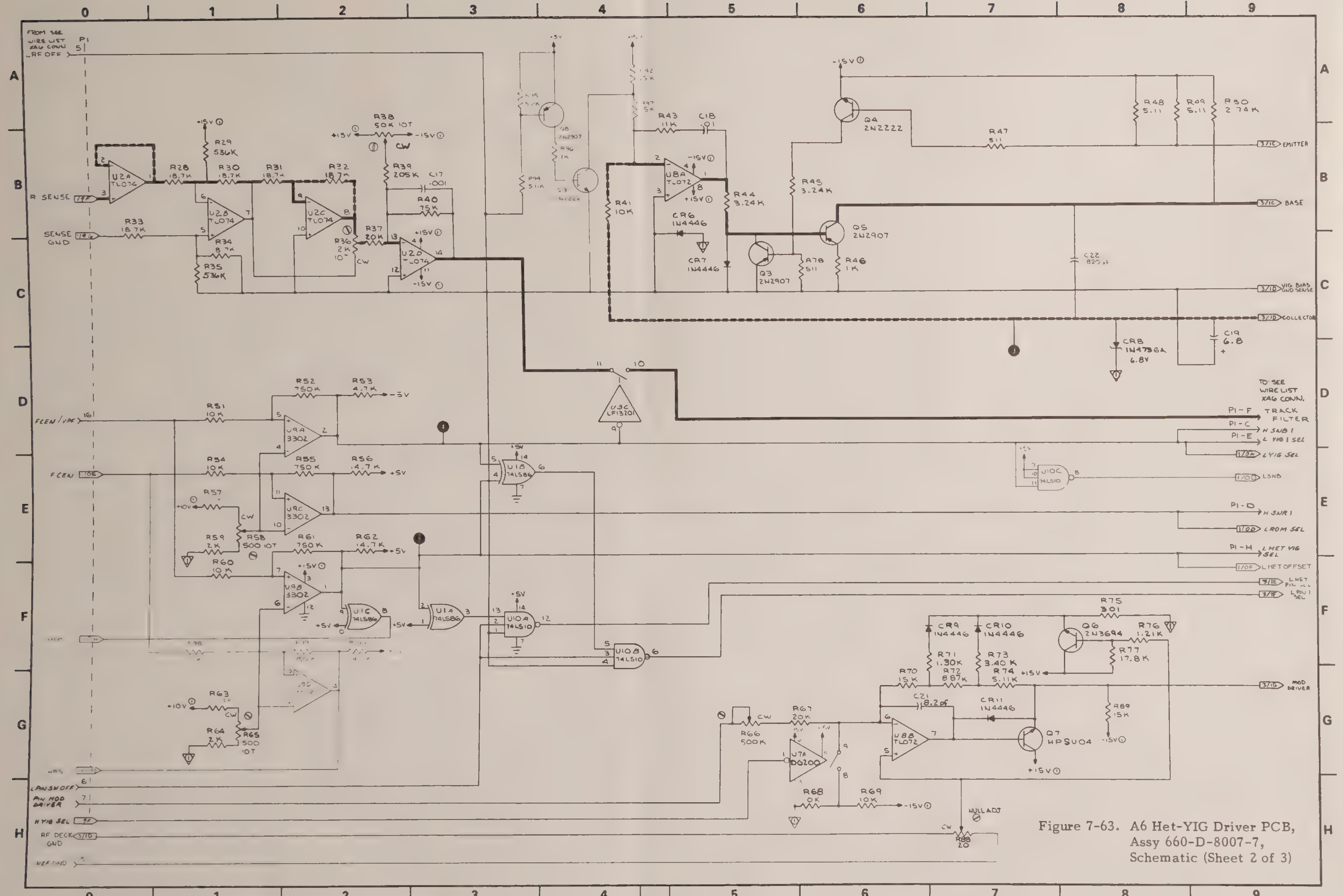
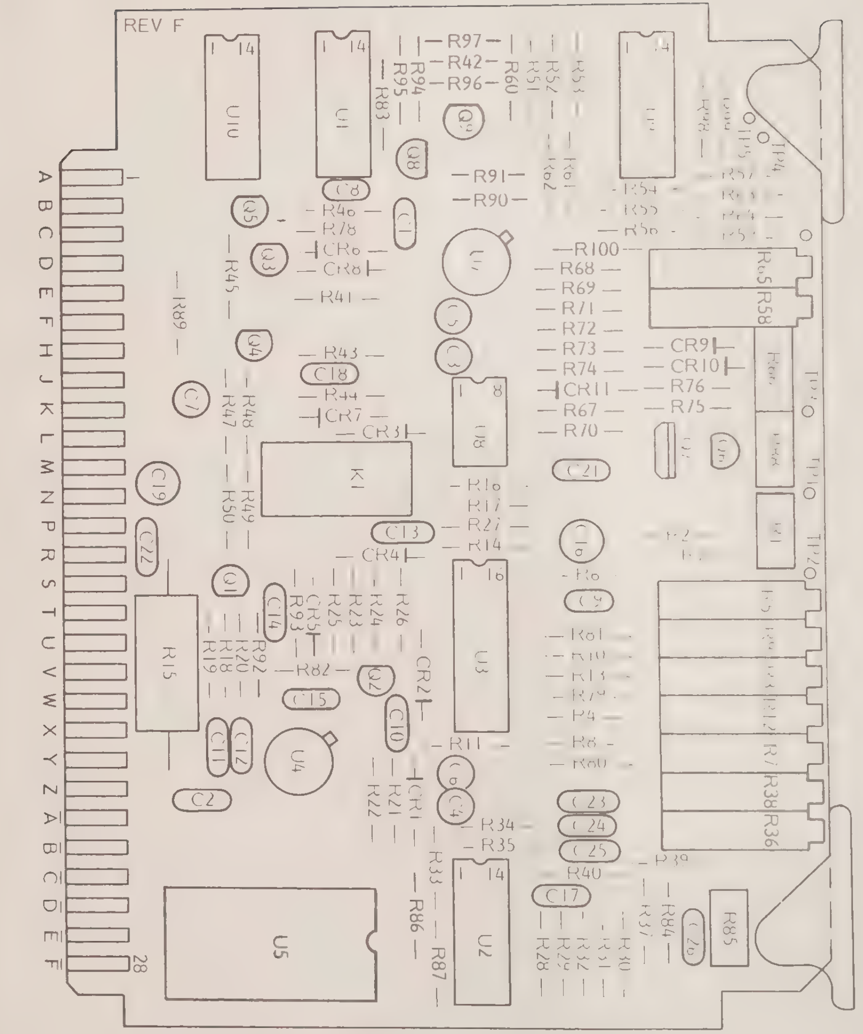
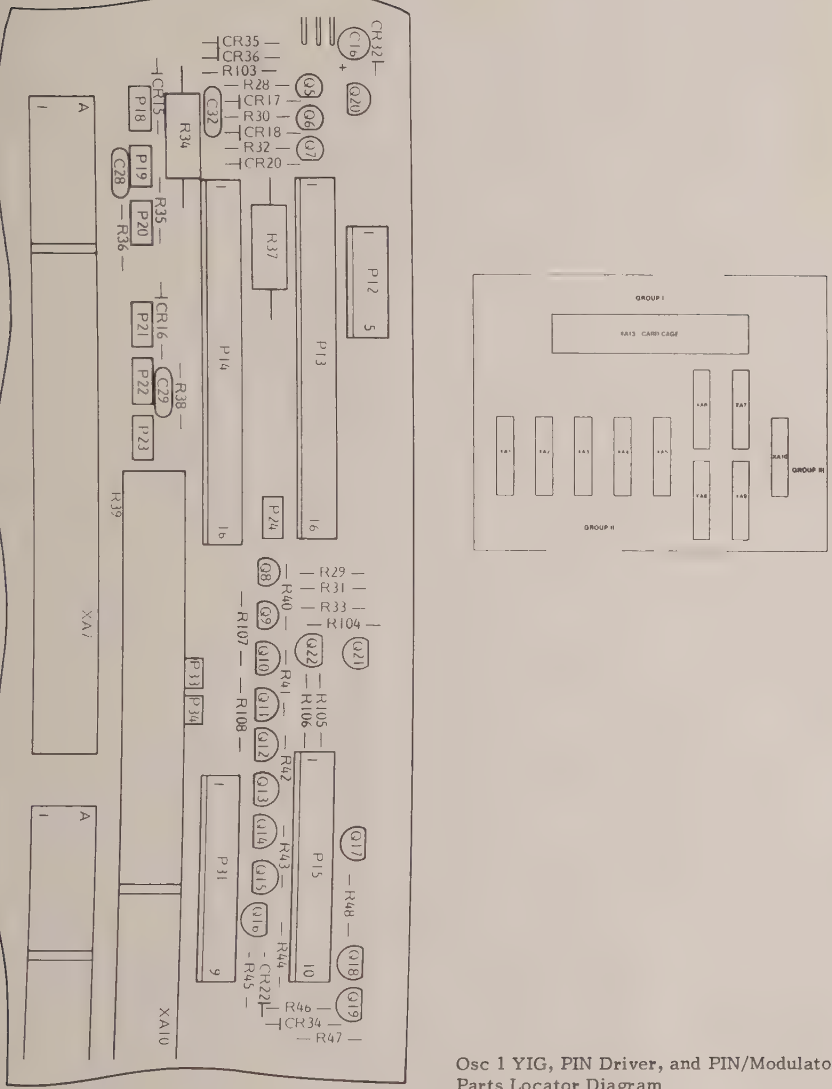

FROM SEE WIRE LIST XA6 CONN.
RF OFF
R SENSE
SENSE GND
U2A TL074
U2B TL074
U2C TL074
U2D TL074
R28 18.7K
R29 536K
R30 18.7K
R31 18.7K
R32 18.7K
R33 18.7K
R34 8.7K
R35 536K
R36 2K 10T
R37 20K
R38 50K 10T
R39 205K
R40 75K
C17 .001
R41 10K
R43 11K
C18 .01
U8A TL072
CR6 1N4446
CR7 1N4446
Q3 2N2907
R78 511
R44 3.24K
R45 3.24K
Q4 2N2222
Q5 2N2907
R46 1K
R47 511
R48 5.11
R49 5.11
R50 2.74K
C22 825pf
CR8 1N4736A 6.8V
C19 6.8
EMITTER
BASE
YIG BIAS GND SENSE
COLLECTOR
U3C LF13201
TO SEE WIRE LIST XA6 CONN.
TRACK FILTER
H SNB1
L YIG I SEL
L YIG SEL
LSNB
H SNR1
L ROM SEL
L HET YIG SEL
L HET OFFSET
L HET PIN ...
L PIN I SEL
MOD DRIVER
FCEN/VPC
FCEN
U9A 3302
U9C 3302
U9B 3302
U1B 74LS86
U1C 74LS86
U1A 74LS86
U10A 74LS10
U10B 74LS10
U10C 74LS10
R51 10K
R52 750K
R53 4.7K
R54 10K
R55 750K
R56 4.7K
R57
R58 500 10T
R59 2K
R60 10K
R61 750K
R62 4.7K
R63
R64 2K
R65 500 10T
R66 500K
R67 20K
R68 0K
R69 10K
U7A DG200
U8B TL072
C21 8.2pf
CR9 1N4446
CR10 1N4446
CR11 1N4446
R70 15K
R71 1.30K
R72 887K
R73 3.40K
R74 5.11K
R75 301
R76 1.21K
R77 17.8K
Q6 2N3694
Q7 HPSU04
R89 15K
R88 20
NULL ADJ
L PIN SHOFF
PIN MOD DRIVER
H YIG SEL
RF DECK GND
REF GND
+15V
-15V
+5V
+10V
CW
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

Figure 7-63. A6 Het-YIG Driver PCB, Assy 660-D-8007-7, Schematic (Sheet 2 of 3)


REV F
U10
U1
U5
U2
U3
U4
U6
U7
U8
K1
R15
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
A B C D E F H J K L M N P R S T U V W X Y Z A B C D E F
28

A6 PCB Parts Locator Diagram

Figure 7-63 (Sheet 1 of 3)


CR35
CR36
R103
R28
CR17
R30
CR18
R32
CR20
CR15
R34
C32
P18
P19
C28
P20
R35
R36
CR32
C16
Q20
Q5
Q6
Q7
R37
P12
P13
P14
CR16
P21
P22
C29
R38
P23
P24
R39
XA7
A
Q8
R29
R31
R33
R104
R40
Q9
R107
Q10
R41
Q21
Q22
R105
R106
R108
Q11
Q12
R42
Q13
Q14
R43
Q15
Q16
R44
CR22
R45
R46
CR34
R47
P15
P31
P33
P34
Q17
R48
Q18
Q19
XA10
GROUP I
XA13 CARD CAGE
GROUP II
GROUP III

Osc 1 YIG, PIN Driver, and PIN/Modulator Parts Locator Diagram

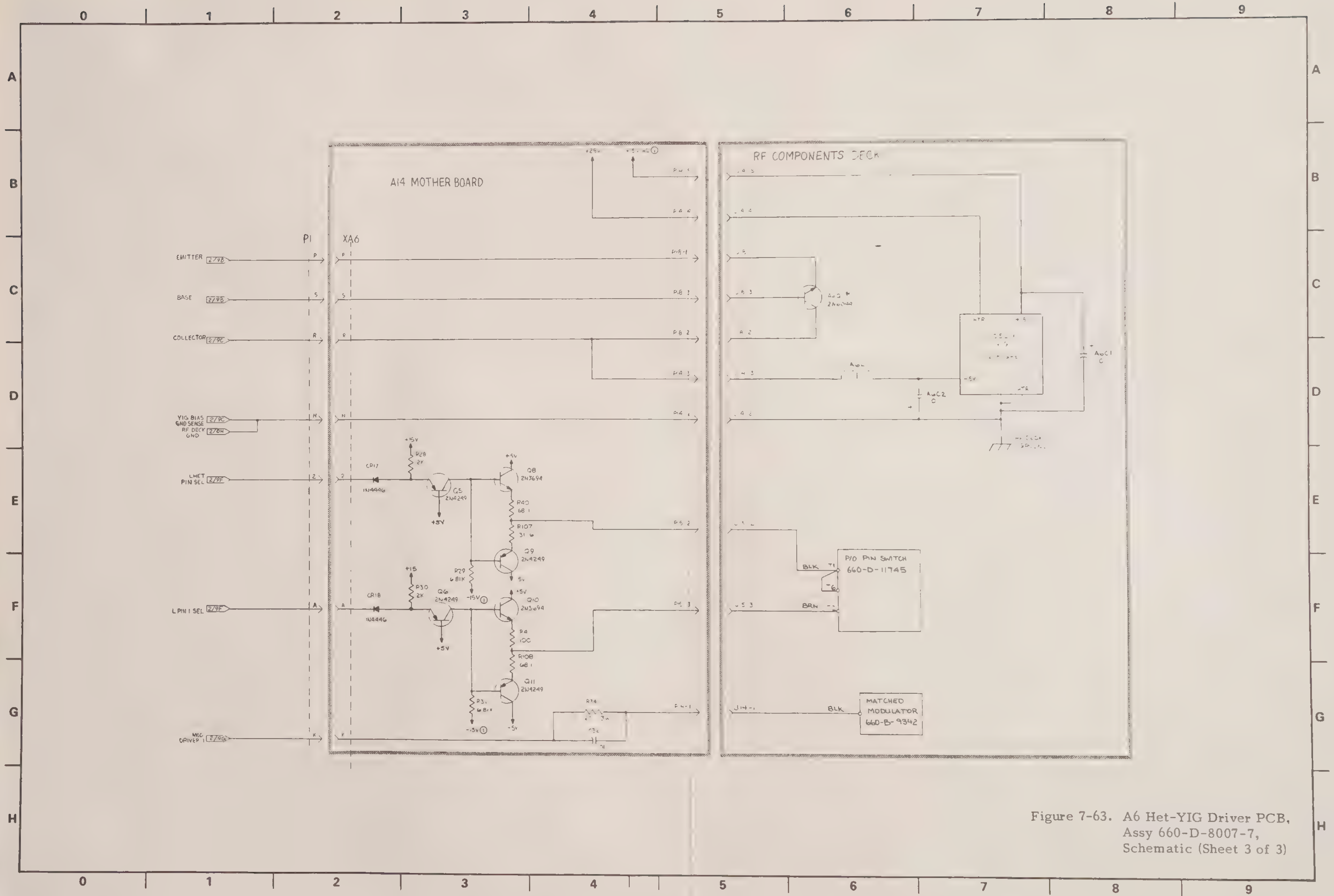
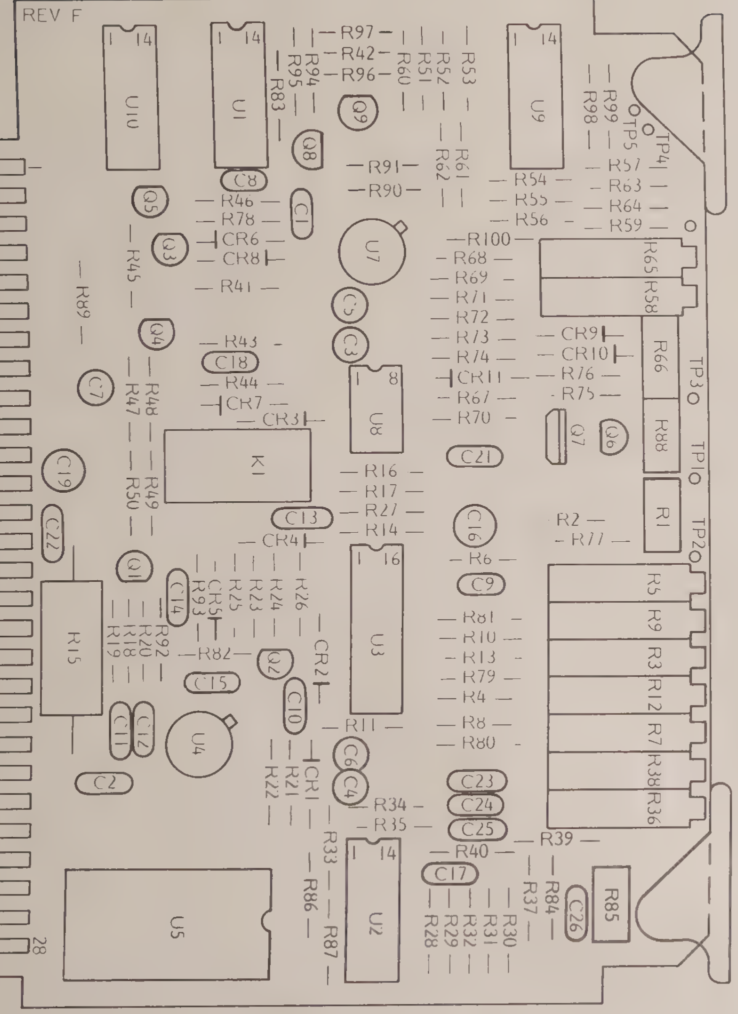

A14 MOTHER BOARD
RF COMPONENTS DECK
P1
XA6
EMITTER
BASE
COLLECTOR
YIG BIAS
GAS SENSE
RF DECK GND
LHET PIN SEL
L PIN 1 SEL
MOD DRIVER 1
CR17
1N4446
CR18
1N4446
R28
2K
R30
2K
Q5
2N4249
Q6
2N4249
Q8
2N3694
Q9
2N4249
Q10
2N3694
Q11
2N4249
R40
68.1
R107
31.6
R29
6.81K
R31
6.81K
R108
68.1
R34
+5V
+15
-15V
P/O PIN SWITCH
660-D-11745
BLK
BRN
MATCHED MODULATOR
660-B-9342

Figure 7-63. A6 Het-YIG Driver PCB, Assy 660-D-8007-7, Schematic (Sheet 3 of 3)

parts locator


REV F
U10
U1
U9
U7
U8
U3
U4
U2
U5
K1
R15
TP1
TP2
TP3
TP4
TP5
28
A B C D E F H J K L M N P R S T U V W X Y Z Ā B̄ C̄ D̄ Ē F̄

A6 PCB Parts Locator Diagram

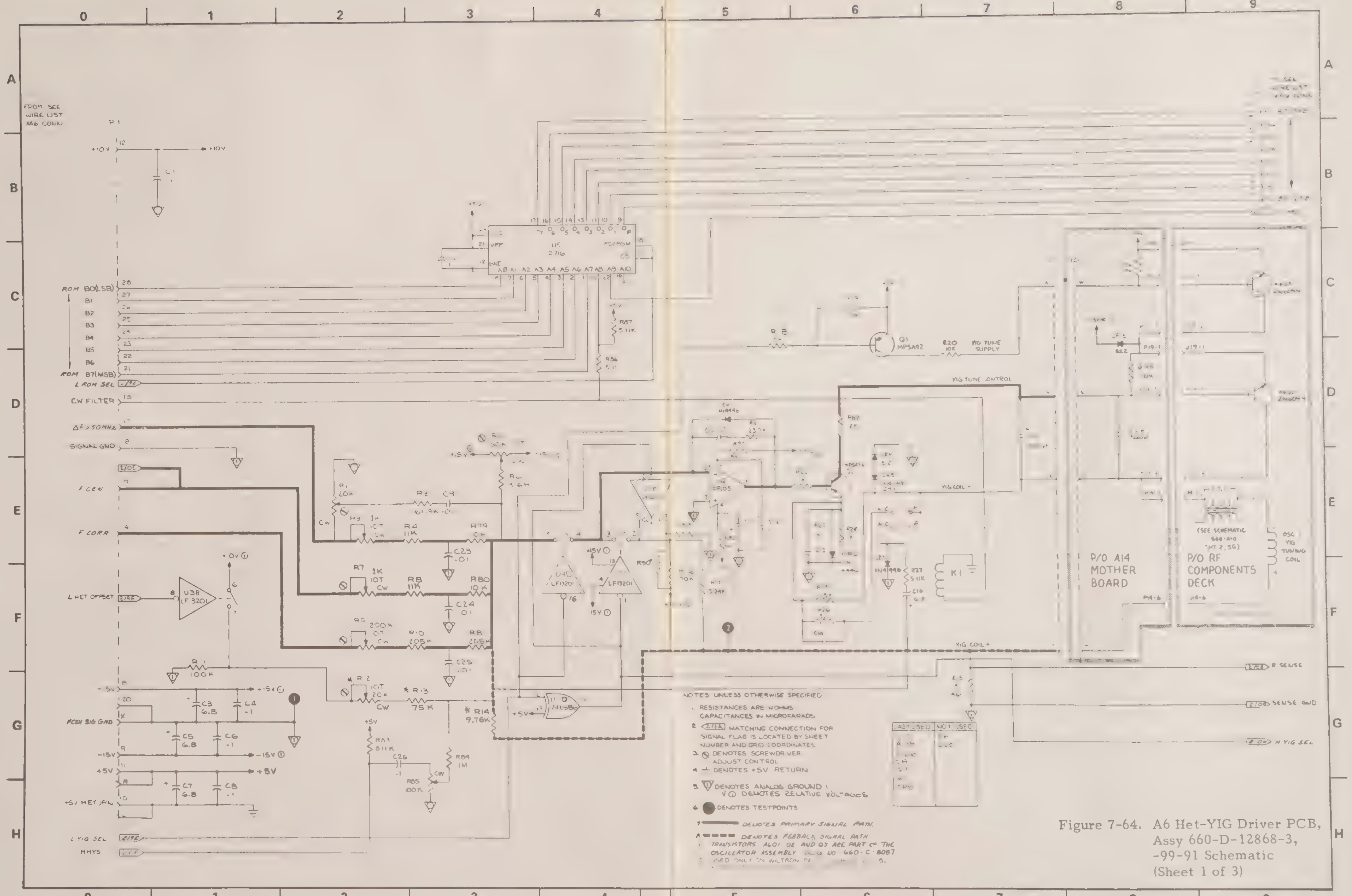

FROM SEE WIRE LIST XA6 CONN
P1
+10V
ROM B0(LSB)
B1
B2
B3
B4
B5
B6
ROM B7(MSB)
L ROM SEL
CW FILTER
ΔF > 50MHz
SIGNAL GND
F CEN
F CORR
L HET OFFSET
+5V
FCEN SIG GND
-15V
+5V
+5V RET
L YIG SEL
RHYS
U1 2716
U3B LF 3201
U4
LF13201
Q1 MPSA92
YIG TUNE CONTROL
YIG COIL +
P/O A14 MOTHER BOARD
P/O RF COMPONENTS DECK
K1
P SENSE
SENSE GND
H YIG SEL
NOTES UNLESS OTHERWISE SPECIFIED
1. RESISTANCES ARE IN OHMS CAPACITANCES IN MICROFARADS
2 MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES
3 DENOTES SCREWDRIVER ADJUST CONTROL
4 DENOTES +5V RETURN
5 DENOTES ANALOG GROUND 1
V① DENOTES RELATIVE VOLTAGES
6 DENOTES TESTPOINTS
7 DENOTES PRIMARY SIGNAL PATH.
8 DENOTES FEEBACK SIGNAL PATH
TRANSISTORS A6Q1 Q2 AND Q3 ARE PART OF THE OSCILLATOR ASSEMBLY DWG NO 660-C-8087
LAST USED
NOT USED
0 1 2 3 4 5 6 7 8 9
A B C D E F G H

Figure 7-64. A6 Het-YIG Driver PCB, Assy 660-D-12868-3, -99-91 Schematic (Sheet 1 of 3)

parts locator

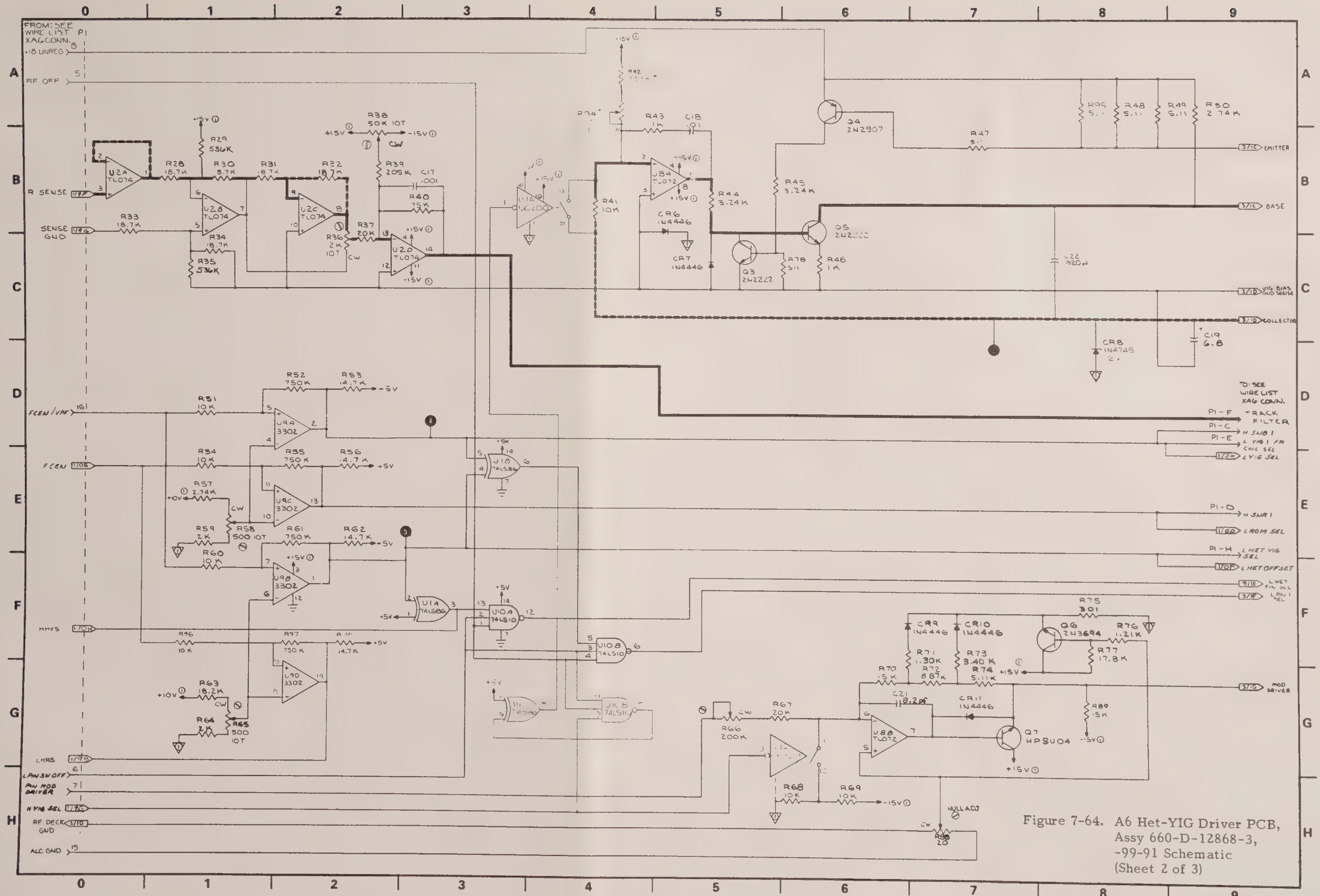

FROM: SEE WIRE LIST P1 XA6 CONN.
+18 UNREG
RF OFF
R SENSE
SENSE GND
U2A TL074
U2B TL074
U2C TL074
U2D TL074
R28 18.7K
R29 536K
R30 8.7K
R31 18.7K
R32 18.7K
R33 18.7K
R34 18.7K
R35 536K
R36 2K 10T
R37 20K
R38 50K 10T
R39 205K
R40 75K
C17 .001
CW
+15V
-15V
U17A
R41 10K
R42
R43 1K
C18 .01
U8A TL072
R44 3.24K
R45 3.24K
R46 1K
R47
CR6 1N4446
CR7 1N4446
Q3 2N2222
Q4 2N2907
Q5 2N2222
R78 511
R95
R48 5.11
R49 5.11
R50 2.74K
C22 820pf
CR8 1N4745
C19 6.8
EMITTER
BASE
YIG BIAS GND SENSE
COLLECTOR
TO: SEE WIRE LIST XA6 CONN.
P1-F +TRACK FILTER
P1-C H SUB 1
P1-E L YIG 1 FM COIL SEL
L YIG SEL
FCEN/VPF
FCEN
R51 10K
R52 750K
R53 14.7K
R54 10K
R55 750K
R56 14.7K
R57 2.74K
R58 500 10T
R59 2K
R60 10K
R61 750K
R62 14.7K
U9A 3302
U9B 3302
U9C 3302
U9D 3302
U1B 74LS86
U1A 74LS86
U10A 74LS10
U10B 74LS10
P1-D H SNR 1
L ROM SEL
P1-H L HET YIG SEL
L HET OFFSET
L HET PIN SEL
L PIN 1 SEL
HHYS
R96 10K
R97 750K
14.7K
R63 18.2K
R64 2K
R65 500 10T
+10V
+5V
LHRS
L PIN SW OFF
PIN MOD DRIVER
H YIG SEL
RF DECK GND
ALC GND
CR9 1N4446
CR10 1N4446
R70 15K
R71 1.30K
R72 887K
R73 3.40K
R74 5.11K
R75 301
R76 1.21K
R77 17.8K
Q6 2N3694
C21 8.2pf
CR11 1N4446
R66 200K
R67 20K
R68 10K
R69 10K
U8B TL072
Q7 HPSU04
R89 15K
MOD DRIVER
NULL ADJ
R88 20
A
B
C
D
E
F
G
H
0
1
2
3
4
5
6
7
8
9

Figure 7-64. A6 Het-YIG Driver PCB, Assy 660-D-12868-3, -99-91 Schematic (Sheet 2 of 3)

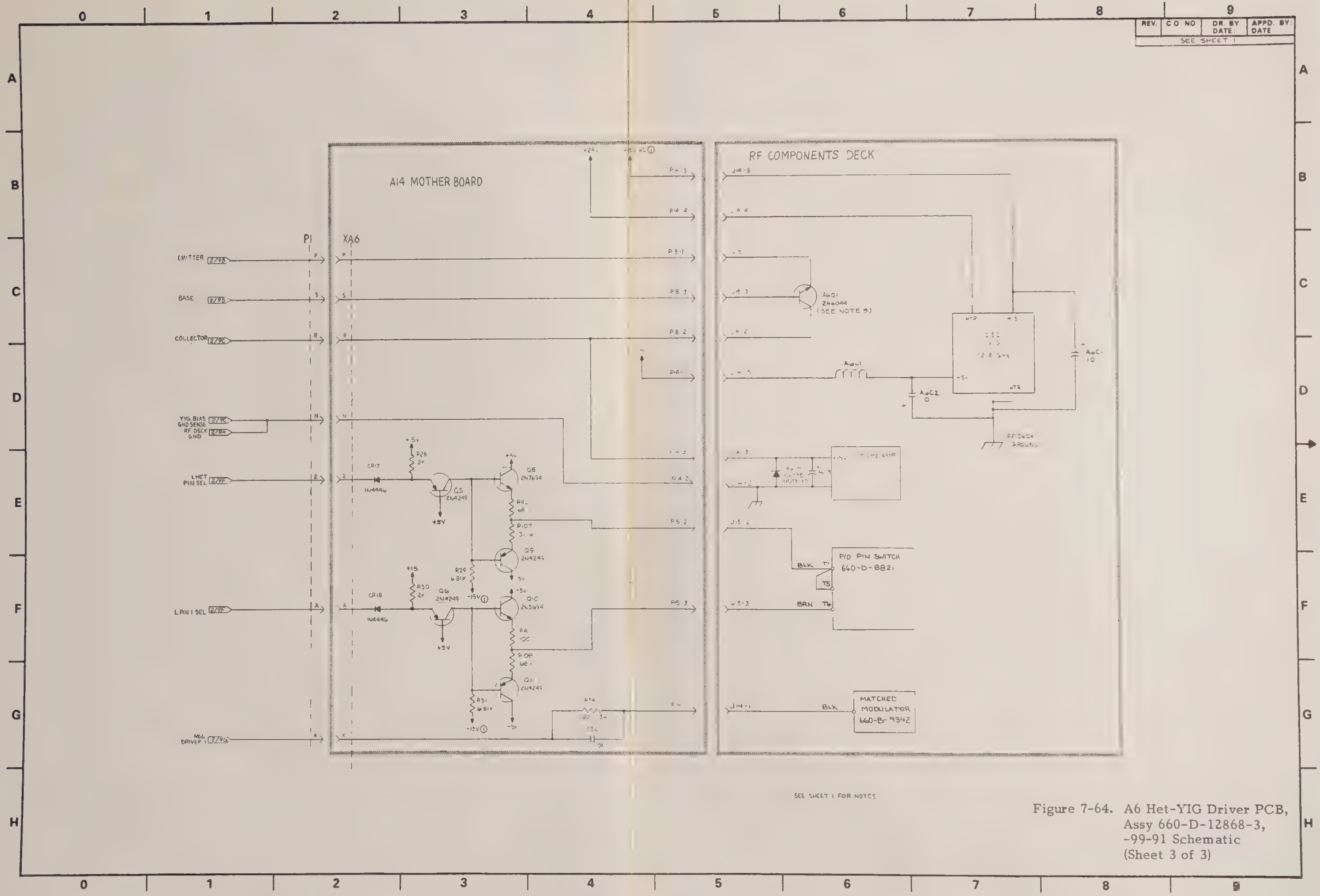
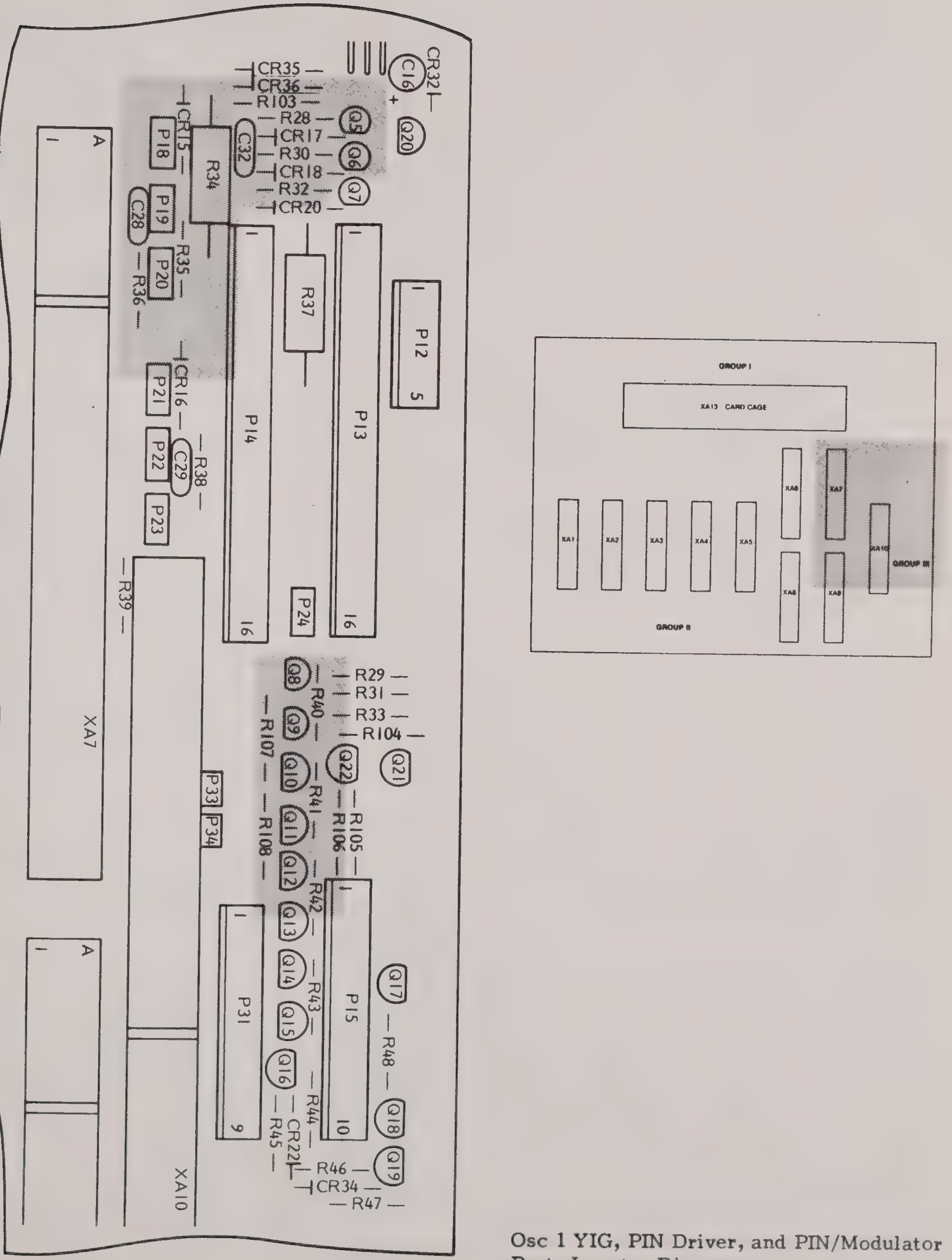

REV.
C O NO
DR. BY DATE:
APPD. BY: DATE
SEE SHEET 1
A14 MOTHER BOARD
RF COMPONENTS DECK
P1
XA6
EMITTER 2/9B
BASE 2/9B
COLLECTOR 2/9C
YIG BIAS GND SENSE 2/9C
RF DECK GND 2/0H
LHET PIN SEL 2/9F
L PIN 1 SEL 2/9F
MOD DRIVER 1 2/9G
CR17
1N4446
R28 2K
+5V
Q5 2N4249
Q8 2N3694
R107
Q9 2N4249
R29 681K
-15V ①
+15
R30 2K
CR18
1N4446
Q6 2N4249
Q10 2N3694
R108
Q11 2N4249
R31 681K
-5V
P8-1
P8 3
P8 2
P15 3
J14-5
A6Q1
2N6044
(SEE NOTE 9)
A6L1
A6C2
A6C1 10
12.8 GHz
HTR
RF DECK GROUND
P/O PIN SWITCH 660-D-8821
BLK
T1
T5
BRN
T6
J14-1
MATCHED MODULATOR 660-B-9342
SEE SHEET 1 FOR NOTES

Figure 7-64. A6 Het-YIG Driver PCB, Assy 660-D-12868-3, -99-91 Schematic (Sheet 3 of 3)


CR32
C16
Q20
CR35
CR36
R103
R28
Q5
CR17
R30
Q6
CR18
R32
Q7
CR20
C32
R34
CR15
P18
P19
C28
P20
R35
R36
R37
P12
1
5
P13
16
P14
16
CR16
P21
P22
C29
R38
P23
R39
P24
A
1
XA7
R29
R31
R33
R104
Q8
R40
Q9
R107
Q10
Q22
Q21
R41
R105
R106
Q11
R108
Q12
R42
Q13
Q14
Q15
Q16
R43
R44
R45
CR22
R46
CR34
R47
Q17
R48
Q18
Q19
P15
10
P31
9
P33
P34
XA10
GROUP I
XA13 CARD CAGE
XA1
XA2
XA3
XA4
XA5
XA6
XA7
XA8
XA9
XA10
GROUP II
GROUP III

Osc 1 YIG, PIN Driver, and PIN/Modulator Parts Locator Diagram

7-12.4 Assy 660-D-8007-4 Het/YIG Driver PCB, Circuit Description

The Het/YIG Driver PCB provides the drive current and bias voltage for the 4.61 to 6.6 GHz YIG oscillator, which is heterodyned with a 4.6 GHz fixed oscillator to generate the .01 to 2 GHz output frequency. The A6 PCB also provides the following:

- A modulating current for the MOD 1 (Modulator) component.
- A switching current for the MOD 2 (PIN Switch) component.
- Linearizing ROM output data. (A linearizing ROM, if installed, provides frequency correction data for making the frequency characteristics of the YIG oscillator linear.)

A block diagram for the Het/YIG Driver PCB is shown in Figure 7-65. A simplified schematic of the E/I (voltage to current) Converter circuit is shown in Figure 7-66. And the PCB schematic (3 sheets) is provided in Figure 7-67.

The **F CEN, ΔF>50 MHz,** and **F CORR** signals generated on the A5 PCB are summed together at the E/I Converter (Figure 7-65) and used to generate the YIG tuning coil current. The output of this YIG is a sweeping frequency, 4.61 to 6.6 GHz. This sweeping output is applied to a mixer in the Heterodyne Converter Assembly, where it is beat with a 4.6 GHz oscillator. The mixer product, a sweep .01 to 2 GHz, is amplified and applied to the RF output circuit (paragraph 7-14).

As shown in Figure 7-66, the three A5 voltage signals – along with a heterodyne offset voltage via R12 – are applied to U4. The output from U4 controls the current through the YIG tuning coil, via transistor A6Q2 (located on the RF Deck). (-38V is applied to the emitter of A6Q2 via A6Q3, which is used as a voltage switch in other 6600A Series models.) The current through the YIG coil develops a proportional voltage drop across sense resistor (R SENSE) R15.

The remaining input to the E/I Converter is the **CW FILTER** line. When the microprocessor commands that the CW filter be inserted, relay K1 is activated. (The CW filter is inserted when the sweep width is ≤50 MHz or when a CW mode has been selected from the front panel.) When K1 is activated, the R27-C16 network creates an alternate negative-feedback path around the YIG oscillator. This path reduces the noise current flowing through the coil; thereby quieting the YIG oscillator frequency output.

As shown in Figure 7-65, the voltage developed across R15 provides the input for the Tracking Filter Voltage Generator (U2A-U2D). This circuit is not presently used with the 6609A.

The PIN/YIG Select Logic circuit (Figure 7-65) (U1A, U1B, U1C, U10A, U10B) controls the logic states of the **L YIG SEL, L HET YIG SEL, L HET PIN SEL,** and **L PIN SELECT** lines. The **L YIG FM COIL SEL** line is always TRUE. The **L HET YIG SEL** line is always TRUE. And the **L HET PIN SEL** and **L PIN SELECT** lines may be either TRUE or FALSE, depending upon the logic states of the input **L RF OFF** and **L PIN SW OFF** lines. The **L RF OFF** input is from the microprocessor, via a latch on the A4 PCB. The **L PIN SW OFF** input is from the Sq Wave Sample/Hold Logic circuit on the A4 PCB (paragraph 7-11.1g). When either of these two logic inputs goes TRUE, both the **L HET PIN SEL** and **L PIN SEL** lines go FALSE.

When the **L HET PIN SEL** line is FALSE, it reverse-biases A14CR17 (Figure 7-67, Sheet 3). Reverse-biasing CR17 causes A14Q5 to turn on, A14Q8 to turn on, and A14Q9 to turn off. When on, Q8 sources current into the MOD (PIN Switch).

Conversely, when the **L HET PIN SEL** Line is TRUE, CR17 is forward-biased. Forward-biasing CR17 causes Q5 to turn off, Q8 to turn off, and Q9 to turn on. When on, Q9 sinks current from the MOD (PIN Switch).

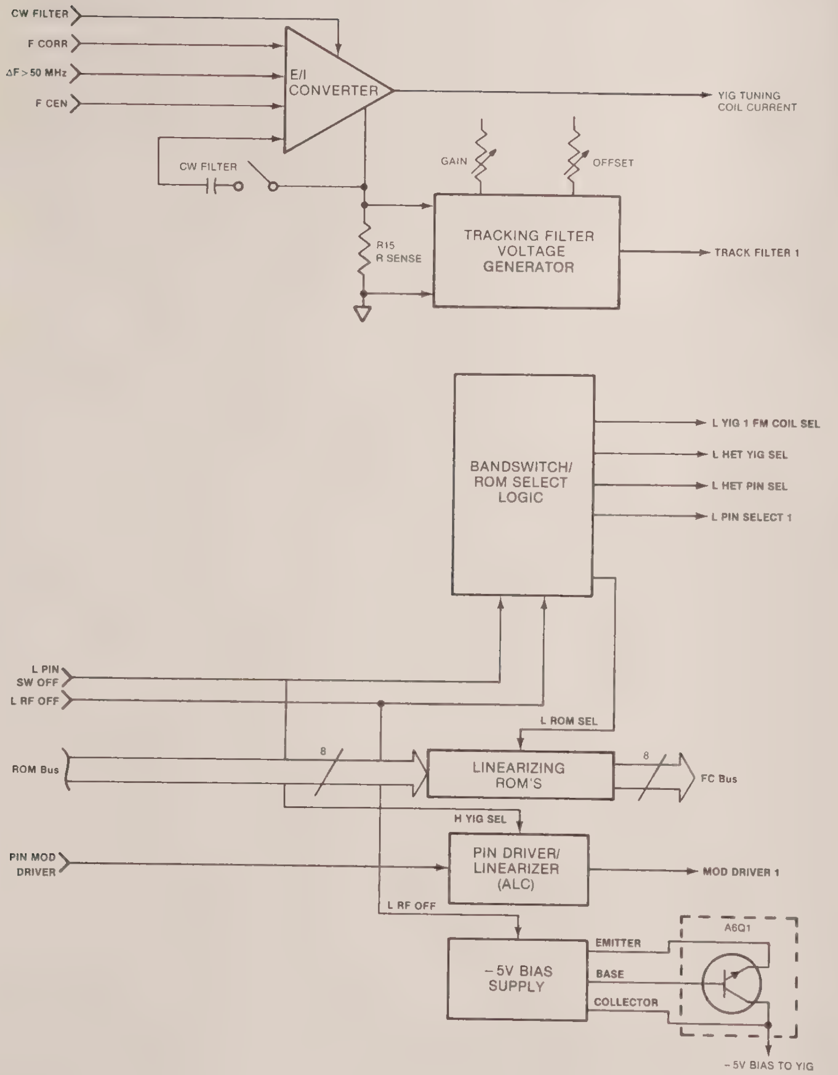
Sourcing current into MOD 2 (PIN Switch) effectively "opens" the RF output circuit. Conversely, sinking current from the switch "closes" the circuit. This switch is used to apply square-wave modulation to the RF output energy.

Para. 7-12.4 (cont'd.)

The inputs to the Linearizing ROM (U5) are the **ROM Bus** lines from the microprocessor, via the A14U6 latch on the motherboard. The Linearizing ROM is enabled by the TRUE state of the **L ROM SEL** line from the Bandswitch Logic circuit. This ROM outputs eight bits of data to the A5 PCB. This circuitry is not presently used with the 6609A.

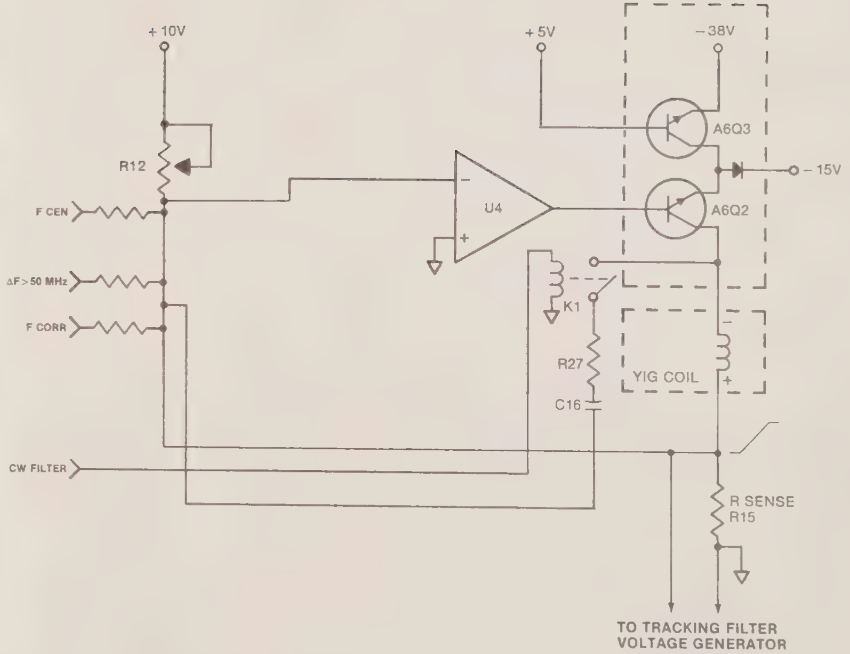
The input to the PIN Driver (ALC) circuit (U7, U8, Q6, Q7) is from the A4 PCB. This circuit has two functions: (1) It provides the ALC-loop-gain adjustment, and (2) it makes linear the relationship between the A4 PCB Level Amp output in Vdc (paragraph 7-11.1) and the RF power output in dBm. The output from this circuit is a current: **MOD DRIVER.** This current is supplied to MOD 1 on the RF Deck, via A14R34 (Figure 7-65, Sheet 3).

The input to the -5V Bias Supply (U7A, U8A, Q3, Q4, Q5) is the control line, **L RF OFF.** When the front panel RF ON switch is disengaged (out), the microprocessor sets this line TRUE. When **L RF OFF** is TRUE, the -5V Bias Supply is turned off, thus turning off the YIG oscillator.



CW FILTER
F CORR
ΔF > 50 MHz
F CEN
E/I CONVERTER
YIG TUNING COIL CURRENT
CW FILTER
GAIN
OFFSET
R15 R SENSE
TRACKING FILTER VOLTAGE GENERATOR
TRACK FILTER 1
BANDSWITCH/ ROM SELECT LOGIC
L YIG 1 FM COIL SEL
L HET YIG SEL
L HET PIN SEL
L PIN SELECT 1
L PIN SW OFF
L RF OFF
L ROM SEL
ROM Bus
8
LINEARIZING ROM'S
8
FC Bus
H YIG SEL
PIN MOD DRIVER
PIN DRIVER/ LINEARIZER (ALC)
MOD DRIVER 1
L RF OFF
-5V BIAS SUPPLY
EMITTER
BASE
COLLECTOR
A6Q1
-5V BIAS TO YIG

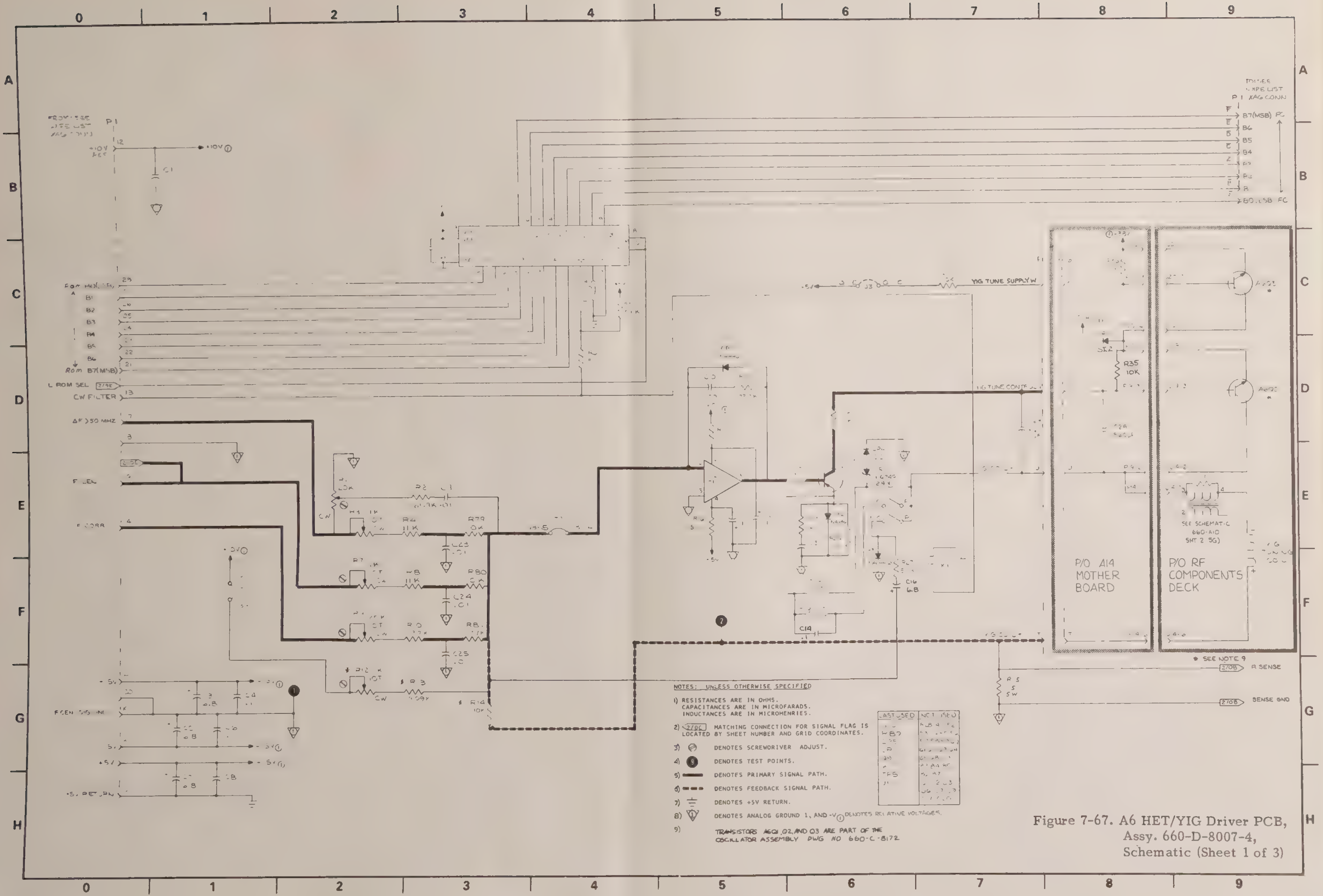
Figure 7-65. Assy 7007-4 YIG Driver PCB Overall Block Diagram



+ 10V
+ 5V
-38V
R12
A6Q3
-15V
F CEN
U4
A6Q2
ΔF > 50 MHz
K1
F CORR
R27
YIG COIL
C16
CW FILTER
R SENSE R15
TO TRACKING FILTER VOLTAGE GENERATOR

Figure 7-66. Assy. 8007-4 E/I Converter Simplified Schematic

Figure 7-65


P/O A14 MOTHER BOARD
P/O RF COMPONENTS DECK
YIG TUNE SUPPLY
R35 10K
C16 6.8
C14
SEE SCHEMATIC 660-A10 SHT 2 5G)
SEE NOTE 9
R SENSE
SENSE GND
L ROM SEL
CW FILTER
ROM B7(MSB)
B0 (LSB)
B7 (MSB)

NOTES: UNLESS OTHERWISE SPECIFIED

1) RESISTANCES ARE IN OHMS.
CAPACITANCES ARE IN MICROFARADS.
INDUCTANCES ARE IN MICROHENRIES.

2) 2/0G MATCHING CONNECTION FOR SIGNAL FLAG IS LOCATED BY SHEET NUMBER AND GRID COORDINATES.

3) ⊘ DENOTES SCREWDRIVER ADJUST.

4) ⑨ DENOTES TEST POINTS.

5) ━━ DENOTES PRIMARY SIGNAL PATH.

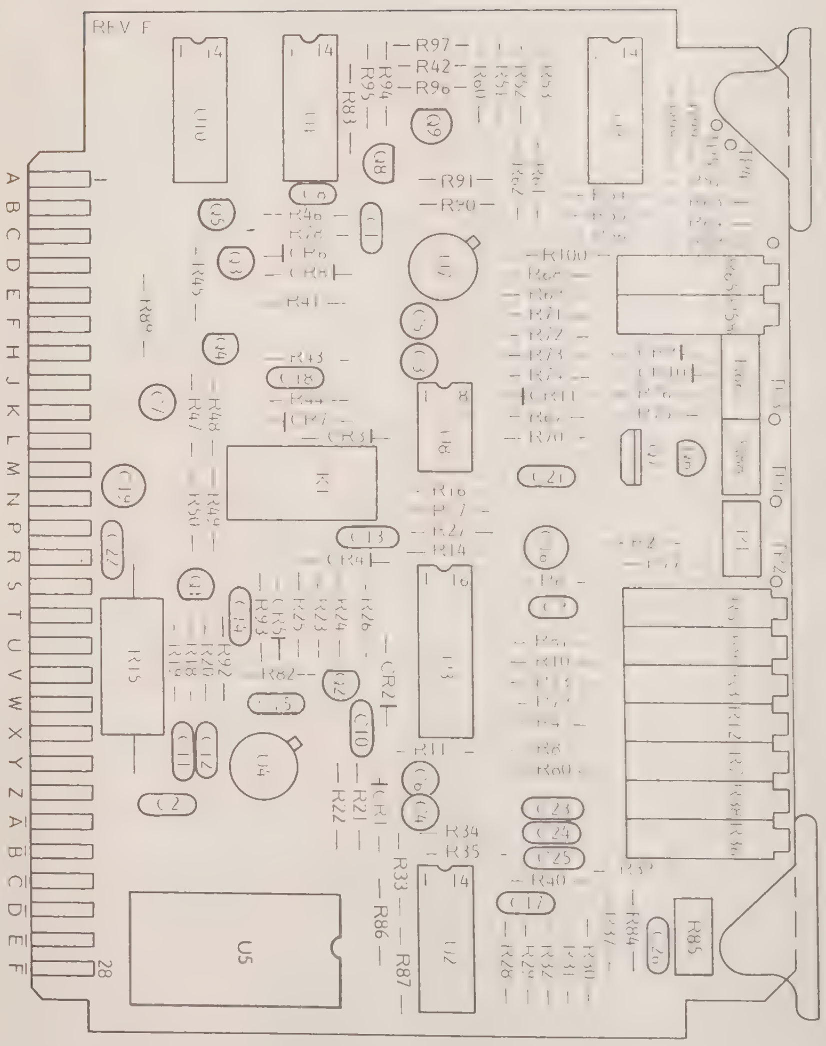
6) ━ ━ ━ DENOTES FEEDBACK SIGNAL PATH.

7) ⏚ DENOTES +5V RETURN.

8) ▽① DENOTES ANALOG GROUND 1, AND -V① DENOTES RELATIVE VOLTAGES.

9) TRANSISTORS A6Q1, Q2, AND Q3 ARE PART OF THE OSCILLATOR ASSEMBLY DWG NO 660-C-8172

Figure 7-67. A6 HET/YIG Driver PCB, Assy. 660-D-8007-4, Schematic (Sheet 1 of 3)


REV F
U5
U10
U11
U12
U13
K1
R15
R85
28

A6 PCB Parts Locator Diagram

Figure 7-67 (Sheet 1 of 3)

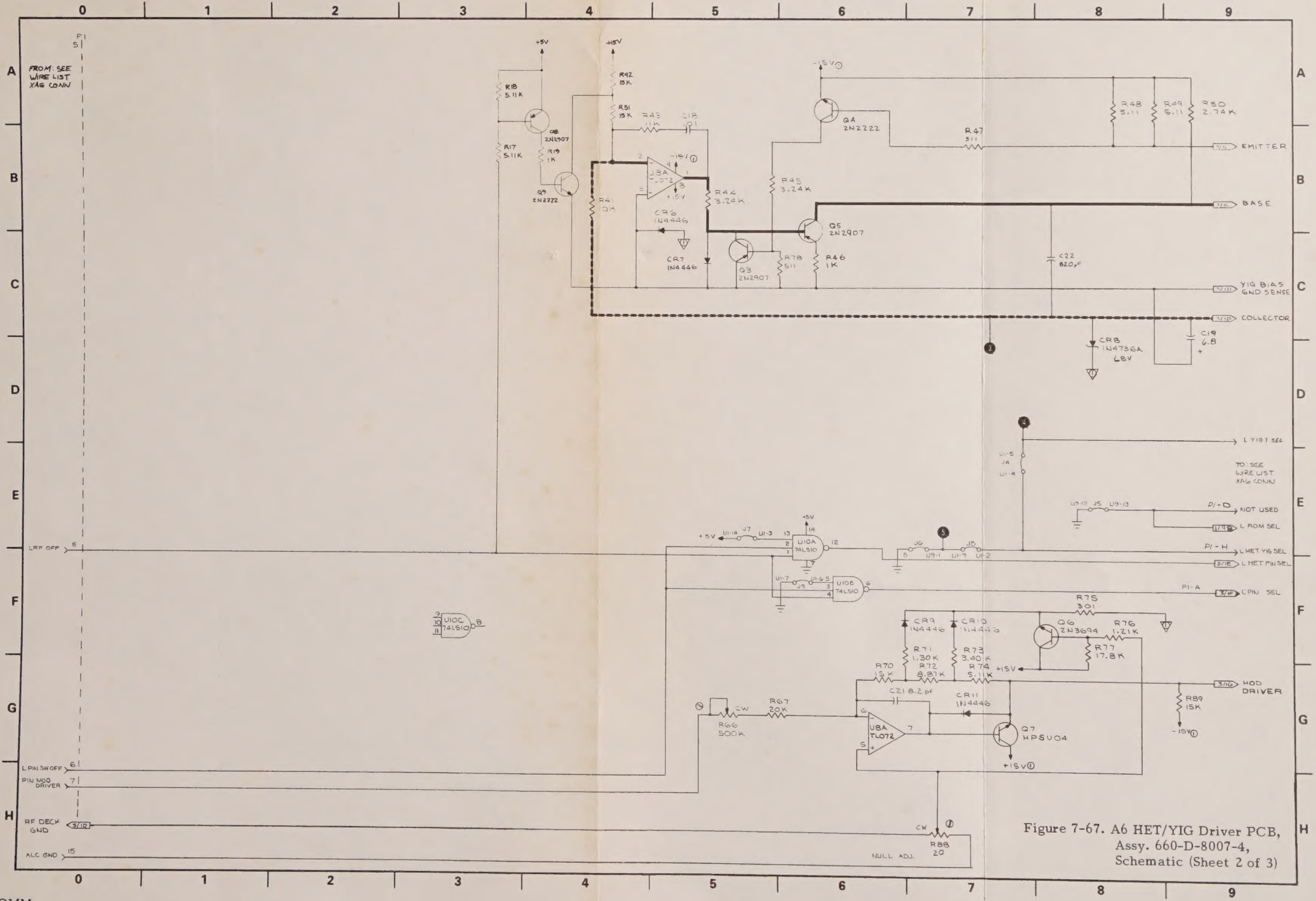

0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
P1
5
FROM: SEE WIRE LIST XA6 CONN
+5V
+15V
R18 5.11K
R17 5.11K
Q8 2N2907
R19 1K
Q9 2N2222
R42 8K
R51 15K
R43 11K
C18 .01
U3A TL072
-15V①
+15V
R41 10K
CR6 1N4446
CR7 1N4446
R44 3.24K
Q3 2N2907
R78 511
R45 3.24K
R46 1K
Q4 2N2222
Q5 2N2907
R47 511
R48 5.11
R49 5.11
R50 2.74K
EMITTER
BASE
C22 820pF
YIG BIAS GND SENSE
COLLECTOR
CR8 1N4736A 6.8V
C19 6.8
L YIG SEL
TO: SEE WIRE LIST XA6 CONN
U1-5 J4 U1-4
U9-12 J5 U9-13
P1-D NOT USED
L ROM SEL
P1-H L HET YIG SEL
L HET PIN SEL
P1-A L PIN SEL
LRF OFF 8
+5V U1-14 J7 U1-3
U10A 74LS10
U10B 74LS10
U10C 74LS10
J6 J8
U9-1 U1-9 U1-2
U1-7 J9 U1-6 5
R75 301
CR9 1N4446
CR10 1N4446
Q6 2N3694
R76 1.21K
R77 17.8K
R71 1.30K
R73 3.40K
R70 15K
R72 8.87K
R74 5.11K
+15V
C21 8.2pF
CR11 1N4446
MOD DRIVER
R89 15K
-15V①
R67 20K
R66 500K
CW
U8A TL072
Q7 HPSU04
+15V①
L PIN SW OFF 6
PIN MOD DRIVER 7
RF DECK GND 3/10
ALC GND 15
NULL ADJ.
R88 20
CW

Figure 7-67. A6 HET/YIG Driver PCB, Assy. 660-D-8007-4, Schematic (Sheet 2 of 3)

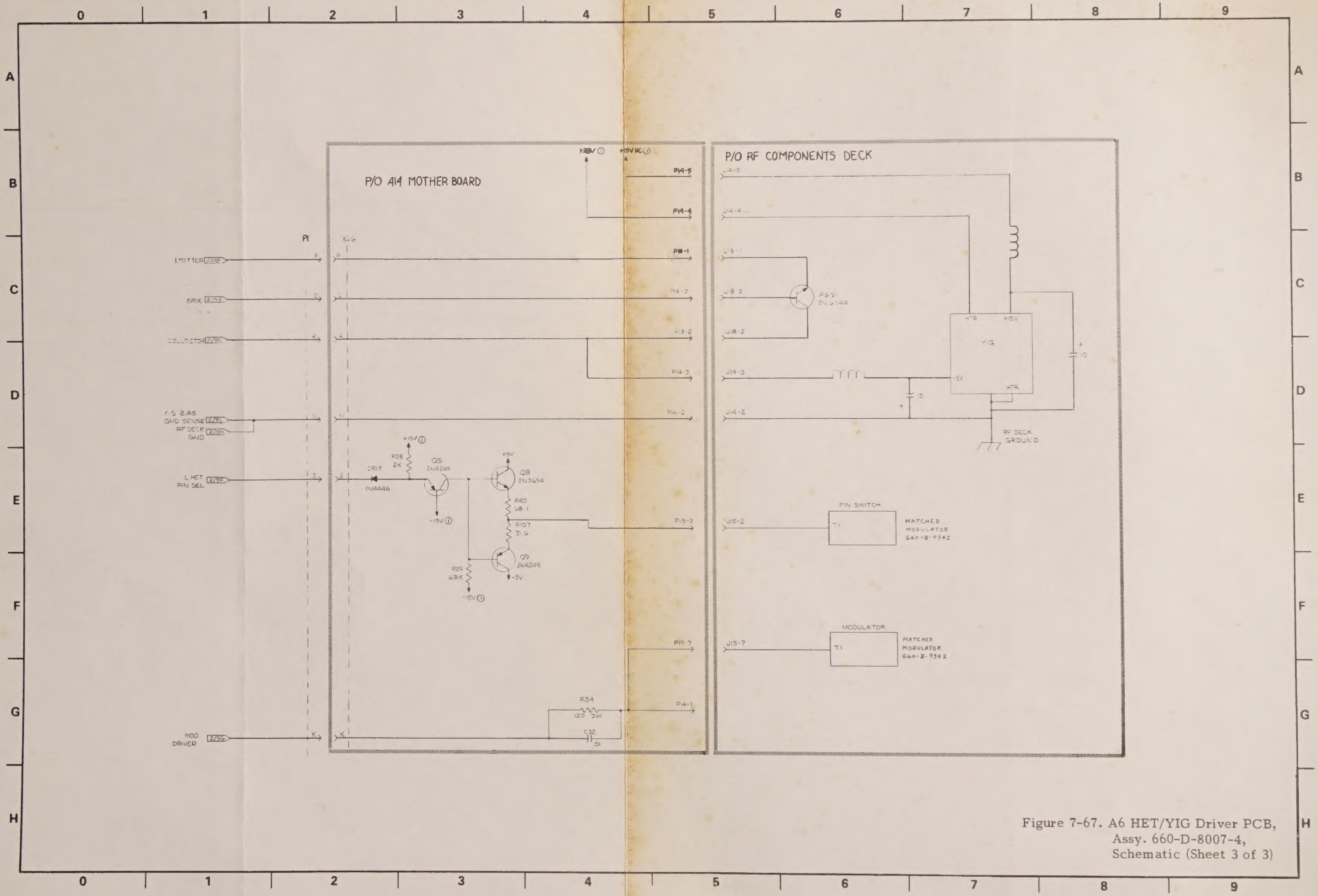

P/O A14 MOTHER BOARD
P/O RF COMPONENTS DECK
P1
XA6
EMITTER 2/9B
BASE 2/9B
COLLECTOR 2/9C
A6 BIAS
GND SENSE 2/9C
RF DECK
GND 2/9H
L HET
PIN SEL 2/9F
MOD
DRIVER 2/9G
F
E
R
N
2
K
+28V ①
+15V NC ①
P14-5
P14-4
P18-1
P18-2
P13-2
P14-3
P14-2
P15-2
P15-7
P14-1
+15V ①
R28
2K
CR17
1N4446
Q5
2N4249
-15V ①
+5V
Q8
2N3694
R40
68.1
R107
31.6
Q9
2N4249
-5V
R29
681K
-15V ①
R34
120 3W
C32
.01
J14-5
J14-4
J18-1
J18-3
J18-2
J14-3
J14-2
A6Q1
2N3744
HTR
+15V
YIG
-5V
HTR
10
10
RF DECK
GROUND
PIN SWITCH
J15-2
T1
MATCHED
MODULATOR
660-B-9342
MODULATOR
J15-7
T1
MATCHED
MODULATOR
660-B-9342
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H

Figure 7-67. A6 HET/YIG Driver PCB,
Assy. 660-D-8007-4,
Schematic (Sheet 3 of 3)

WILTRON

805 E. MIDDLEFIELD ROAD • MOUNTAIN VIEW, CA 94043 • TEL. (415) 969-6500 • TWX 910-379-6578

MP MASTER
MA32397